



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

### Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

### About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

*A Synopsis of  
The Bacteria  
and Yeast Fungi*





600036422N

C  
19119 ε 2.

A SYNOPSIS  
OF THE  
BACTERIA AND YEAST FUNGI



(SCHIZOMYCETES AND SACCHAROMYCETES)

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND  
MICROSCOPICAL SOCIETY

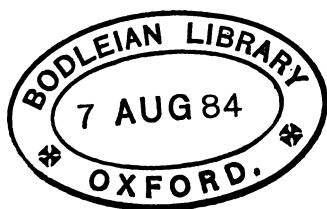


London  
CHATTO AND WINDUS, PICCADILLY

1884

[All rights reserved]

C  
1000000000



## PREFACE.

THE aim of this little work is almost purely morphological ; physiological details are only occasionally introduced. The two first chapters are translated, with additions, the more important of which are indicated by square brackets [ ], from Dr. G. Winter's edition of "Die Pilze," in Rabenhorst's "Kryptogamen-Flora," by kind permission of the author. With a view to increase its usefulness, I have added to the few figures there given a considerable number drawn from various sources, in many cases from the original authorities, and a few of my own. I must acknowledge my indebtedness, for help of various kinds, to Dr. Winter, and also to Dr. John Anthony, of Birmingham, and Mr. James Britten ; and, in addition, to the "Summary of Current Researches," in the *Journal of the Royal Microscopical Society*, as a guide to the literature of the subject.

W. B. GROVE.

BIRMINGHAM,  
May 1st, 1884. .



# CONTENTS.

CHAPTER	PAGE
I. SCHIZOMYCETES ... ..	1
II. SACCHAROMYCETES ... ..	57
III. CLASSIFICATION ... ..	68
IV. PROTEAN AND LITTLE-KNOWN SPECIES ... ..	83
APPENDIX A. ON THE UNIT OF MICROSCOPICAL MEASURE- MENT ... ..	101
„ B. ON THE STAINING OF “BACILLUS TUBERCULOSIS”	103
„ C. DISEASES PRODUCED BY THE SCHIZOMYCETES	105
INDEX ... ..	107



# SYNOPSIS OF THE BACTERIA AND YEAST FUNGI.

## CHAPTER I.

### SCHIZOMYCETES.

*The Schizomycetes, or "splitting-fungi" (Spaltpilze), are unicellular plants, which multiply by repeated subdivision in one, two, or three dimensions of space, and also frequently reproduce themselves by spores, which are formed endogenously.*

*They live, either isolated or combined in various ways, in fluids and in living or dead organisms, in which they produce decompositions and fermentations, but never alcoholic fermentation.*

The Schizomycetes are one of the most difficult and least-known classes of Fungi. In the first place, it is doubtful whether they are to be reckoned among the Fungi or not. Cohn unites them with the Phycobromaceæ, which are usually considered to be Algæ, and includes both groups under the name of Schizophytæ. I cannot agree to this union. With respect to morphological relations, indeed, the Schizomycetes are in many ways exceedingly like the Phycobromaceæ; but their physiological relations are quite

## 2    *Synopsis of the Bacteria and Yeast Fungi.*

different. The latter live, like all Algæ, in pure water, which contains comparatively little organic matter; or they are found on dripping rocks, on damp ground, etc.; they produce no striking decompositions in the water which they inhabit, and they soon perish in a putrefying liquid.

It is quite otherwise with the Schizomycetes, which, on account of their want of chlorophyll, are reduced to live on ready-organized substances, as are Fungi generally. The Schizomycetes, therefore, produce in their substratum, or in the fluid which they inhabit, very considerable and striking decompositions. They perish in pure water, containing no decomposable substance. They grow, therefore, exclusively in organic liquids, or in water or on damp spots where there is an abundance of organized matter.

Though we are thus certainly justified in separating the Schizomycetes from the Phycochromaceæ, *i.e.* from the Algæ, it still remains to be decided how they are to be limited from the animal kingdom. In fact, the Schizomycetes stand at that stage in the evolution of organic beings at which it is not possible to draw a sharp line of demarcation between the two kingdoms. Their kinship with the mouthless monads has often been remarked, and one is inclined more and more to unite the latter with them. I restrict myself to indicating this point, while provisionally I still exclude these forms from the Schizomycetes; they require much further and exhaustive study. Unfortunately this is true in a high degree of the Schizomycetes themselves; both the morphological and systematic as well as the physiological relations of this group of Fungi are still very insufficiently investigated. Doubts and uncertainties of many kinds have still to be removed.

Among the forms which are included among the Schizomycetes in the following pages, are many which have often

hitherto been described as Algæ, but which, on account of their want of chlorophyll, and their decomposing power, must be reckoned among the Fungi.

The Fungi here treated of are the smallest with which we are acquainted. The form of the cells is various—round, ovate, elliptic, cylindrical, etc. They live isolated, singly or in larger or smaller swarms, or in many cases united in pairs, or many together in threads or groups. Many forms are always motionless; others, on the contrary, show a more or less active spontaneous movement, which is frequently effected by flagella. In this case the cells swim about swiftly, rotating round their longitudinal axis. In other cases the movement is an oscillating one or the threads alternately bend and straighten themselves, etc.

But even the motile forms for the most part possess certain stages in which they are motionless. In this case, usually, countless aggregated cells excrete a gelatinous or slimy mass, which either presents a sharply bounded, variously shaped contour—round, sac-like, ragged, or even branching—or else is without definite outline. Such a gelatinous colony is designated a *zooglæa*; it is a resting-stage, which often precedes the formation of spores, and often also occurs in typically motionless forms.

The formation of spores is known in many Schizomycetes; it has been most accurately observed in *Bacillus subtilis*, in which I will briefly describe it. The cells of the genus *Bacillus* are short cylindrical rods, which increase by repeated transverse division, and have a flagellum at each end, by the active vibration of which the rod is moved. In spore-formation the greater part of the contents collects at one point of the rod, which often projects as a swelling, and is sharply marked off from the other empty part of the cell. Afterwards this strongly refringent, dark-looking body (the spore)

#### 4 *Synopsis of the Bacteria and Yeast Fungi.*

disarticulates itself from the barren part of the cell, which then perishes, and the mature spore remains behind. These spores possess the power of enduring adverse influences of various kinds without injury to their vitality. They can remain a long time in the ground, and then years after proceed with their development; they can also germinate at once. At germination the spore first loses its brilliancy, and swells up somewhat; then the membrane of the spore bursts in the middle. The inner part of the spore projects through the opening, and grows to a new rod, the base of which is sheathed by the split membrane, which is often not thrown off for some time.

When we attempt to define the genera and species of the Schizomycetes, as we are wont to do with other plants, we encounter great difficulties, which must first be shortly mentioned. The question is—What, in these Fungi, is to be considered a genus and a species?

That there exist a number of different genera, *i.e.* groups of distinct forms, in the Schizomycetes, is almost universally admitted. But there are two opposed views concerning the limitation of these genera. Naegeli recognises only a few very variable groups of forms, while Cohn establishes a whole series of genera, which he sharply distinguishes, and which he divides into numerous species. To me it seems very probable that several really distinct and constant genera exist, *e.g.* *Micrococcus* (in an extended sense), *Bacillus*, *Spirillum*, and *Sarcina*; while others of Cohn's genera are only stages of development. I should decidedly allow that the number of species is far smaller than one would judge from Cohn's classification. For many of these species are very probably only forms which have been differentiated by the influence of various external agencies, and have become more or less constant.

It is in part quite impossible, especially in the genera *Micrococcus*, and *Bacterium*, to indicate morphological distinctions between the species. We are in these cases confined exclusively to physiological distinctions; we employ differences in chemical action for the limitation of species. The Schizomycetes, as has been already stated, excite peculiar decompositions in their substratum; they transform complicated chemical combinations into simpler ones. This chemical action consists (1) in the production and excretion of colouring matters; (2) in the exciting of various fermentations; and (3) in the decomposition of the humours of animal and human bodies, whereby diseases arise. We distinguish, therefore, (1) chromogenous, (2) zymogenous, and (3) pathogenous species respectively.

But especially in relation to those forms which belong to the two last subdivisions does the greatest uncertainty reign. Nay, in regard to the pathogenous Schizomycetes such untrustworthy, even foolish, assertions and so-called observations have been published, that only the greatest foresight can guard against errors.\*

There is left, therefore, especially for the systematist, nothing but to accept Cohn's conscientious researches, provisionally to adopt his classification and nomenclature as the only one which is founded upon botanical principles, and to add to it only what has been discovered by trustworthy investigations. The nonsense which Hallier and Co. have tried to introduce into the science naturally remains unregarded.

\* This arises chiefly from the fact that many medical men, who have tried to investigate these things, have been totally unskilled in the use of the microscope, at any rate with high powers, and have often also been untrained in the methods of observation. An eminent physician of the United States, Dr. Schmidt, solemnly asserted that the *Bacillus tuberculosis* of Koch was only a fat-crystal!—Tr.

## 6 *Synopsis of the Bacteria and Yeast Fungi.*

### KEY TO THE GENERA.

1. Cells round or ovate ... .. 2  
     Cells cylindrical ... .. 5  
     Cells lanceolate, flat, spirally twisted ... .. *Spiromonas*
2. Cells isolated or united in chains or formless gelatinous masses ... .. *Micrococcus*  
     Cells united in considerable numbers in colonies of definite outline 3
3. Colonies hollow, with a simple peripheral cell-layer... .. *Cohnia*  
     Colonies solid, with cells throughout their substance ... 4
4. Cells united in a small but definite number in regular families ... .. *Sarcina*  
     Cells united in a large and indefinite number in irregular colonies ... .. *Ascococcus*  
     [Cells in chains, each chain surrounded by a gelatinous sheath ... .. *Leuconostoc*]
5. Cells shortly cylindrical, single, or loosely combined in twos or a few together ... .. *Bacterium*  
     Cells long, cylindrical, united in threads ... .. 6
6. Threads isolated or felted together ... .. 7  
     Threads enclosed in roundish gelatinous masses ... .. *Myconostoc*
7. Threads unbranched ... .. 8  
     Threads with evident branching ... .. *Cladothrix*
8. Threads straight, or nearly so ... .. 9  
     Threads spirally wound or bent ... .. II
9. Threads conspicuously articulated, rather short ... .. *Bacillus*  
     Threads mostly not conspicuously articulated, long ... .. 10
10. Threads very slender ... .. *Leptothrix*  
     Threads thicker ... .. *Beggiatoa*
11. Threads short, with few spirals, or simply bent, rigid ... .. *Spirillum*  
     Threads longer, with numerous spirals, flexile ... .. *Spirochæta*

### I. **MICROCOCCUS**, Cohn ("Beiträge zur Biologie," i. p. 151.)

Cells colourless or of a pale tint, *round* or *oval-elliptic*, *motionless*, dividing in *one* direction only. The daughter-cells either soon *separate from one another*, or remain *united in a chain of two or more*, or form a zooglœa. Formation of the spores not certainly known.

What I have said above of the distinctions of the species is especially true of this genus. The accepted species of *Micrococcus* show very little or no difference in form and size, and there remains only chemical action as a means of separating the species, which is therefore treated somewhat fully.

#### A.—CHROMOGENOUS SPECIES.

##### 1. *M. prodigiosus*, Cohn (*l.c.*, p. 153).

*Monas prodigiosa*, Ehrenberg.

*Palmella prodigiosa*, Mont.; Cooke, "British Fresh-water Algæ," p. 12.

*Zoogalactina imetropa*, Sette.

*Bacteridium prodigiosum*, Schröter.

Cells round or oval, colourless, about  $\cdot 5$ – $1\ \mu^*$  in diameter; forming at first rose-red, then blood-red, at last pallid gelatinous masses. (Fig. 1.)

On nitrogenous substances, *e.g.* on boiled potatoes, meat, wheat-bread, white of egg, starch-paste, etc.



Fig. 1.—*Micrococcus prodigiosus*, Cohn,  $\times 1200$  (from nature).

*M. prodigiosus* is that organism which produces the long-known peculiar appearance, formerly designated "blood-rain," on bread, on the "host," etc. It forms at first little rose-red points and heaps, which by degrees increase to rounded bright-red spots, and afterwards become confluent into widespread, even dripping, blood-red patches. These consist of a red-tinted mucous mass, in which thousands of millions of *Micrococcus* cells are embedded. These cells are themselves colourless, but they secrete the red colouring matter in the mucus. This colouring matter is very similar to fuchsin in its physical and chemical relations. It is not soluble in water, but completely so in alcohol; the solution, evaporated and again dissolved, is orange-red; the colour is changed by acids into a bright carmine, by alkalis

\*  $1\ \mu$  (pronounced *mu*) =  $\cdot 001$  mm. =  $\frac{1}{25400}$  of an inch, nearly.

8 *Synopsis of the Bacteria and Yeast Fungi.*

into yellow. In the spectroscope it shows, among others, a characteristic broad absorption band in the green.

*Palmella mirifica*, Rabenhorst, can scarcely be anything different. (See *Journal of the Royal Microscopical Society*, 1882, p. 655.)

2. *M. luteus*, Cohn (*l.c.*, p. 153).

*Bacteridium luteum*, Schröter.

Cells elliptic, somewhat larger than in *M. prodigiosus*, with highly refractive cell-contents; forming, on a solid substratum, clear yellow drops, which at first are as large as a poppy-seed, and afterwards as a half-peppercorn; at last drying up to flat shield-shaped umbilicate discs. On nutrient fluids this species forms a thick yellow skin, which becomes plaited when luxuriantly developed.

On boiled potatoes, etc.

Colouring matter insoluble in water, unchanged by sulphuric acid and alkalis.

3. *M. aurantiacus*, Cohn (*l.c.*, p. 154).

*Bacteridium aurantiacum*, Schröter.

Cells oval, about  $1.5 \mu$  long; on a solid substratum in orange-coloured drops and spots, which at last coalesce into equal-sized patches. On nutrient solutions it forms a golden-yellow skin.

On boiled potatoes and eggs.

Colouring matter soluble in water.

4. *M. fulvus*, Cohn (*l.c.*, p. 181).

Cells round, about  $1.5 \mu$  in diameter; at first forming rusty conical tolerably firm drops of  $\frac{1}{4}$  mm. in thickness, which increase and finally produce extended gelatinous masses. (Fig. 2.)

On horse-dung.



Fig. 2.—*Micrococcus fulvus* (after Cohn).

5. *M. chlorinus*, Cohn (*l.c.*, p. 155).

Cells round (?), forming yellowish-green or

sap-green mucous masses, or in fluids sap-green layers, which by degrees colour the whole fluid yellow-green.

On boiled eggs.

The colouring matter is soluble in water; it is not reddened by acids.

6. *M. cyaneus*, Cohn (*l.c.*, p. 156).

*Bacteridium cyaneum*, Schröter.

Cells elliptic; producing on slices of potato an intense blue, which penetrates also into the interior, or even to the opposite side of the slice. In fluids it forms a zooglœa, which at first is colourless, then bluish-green, and at last intense blue.

• On boiled potatoes.

The colouring matter is soluble in water; the solution is at first verdigris-green, but afterwards usually becomes clear blue. It is coloured intense carmine by acids, and then by alkalies blue or sap-green respectively. In the spectroscope it shows no absorption bands, but only a darkening of the less refractive half.

7. *M. violaceus*, Cohn (*l.c.*, p. 157).

*Bacteridium violaceum*, Schröter.

Cells elliptic, larger than those of *M. prodigiosus*; occurring in bright violet-coloured gelatinous drops, which unite to form larger spots, reaching 6 mm. in diameter.

On boiled potatoes.

B.—ZyMOGENOUS SPECIES.

8. *M. ureæ*, Cohn (*l.c.*, p. 158).

Cells round or oval,  $1\cdot25$ – $2\ \mu$  in diameter; isolated or concatenate or forming a zooglœa on the surface of the fluid. (Fig. 4*b*.)

In urine.

*M. ureæ* is the ferment of ammonia fermentation. If fresh urine is allowed to stand exposed at a sufficient temperature ( $30^{\circ}$  C.), it loses its

10 *Synopsis of the Bacteria and Yeast Fungi.*

acid reaction after a few days, becomes neutral, and finally alkaline, while the phenomena of fermentation are observed. The urea disappears and is changed into carbonate of ammonia, while at the same time alkaline urates and phosphate of ammonia and magnesia are eliminated. This decomposition takes place only when the *Micrococcus* is developed in the fluid.

9. **M. Crepusculum** (Ehrenberg), Cohn (*l.c.*, p. 160).

*Monas Crepusculum*, Ehrenberg.



Fig. 3.—*Micrococcus Crepusculum* (after Ehrenberg).

Cells round or shortly oval, very small, scarcely  $2\ \mu$  in diameter; isolated or forming a zoogloea. (Fig. 3.)

In and on various infusions and putrefying fluids.

The common form of *Micrococcus*, which appears in all sorts of decaying substances and in infusions, in company with *Bacterium Termo*.

10. **M. candidus**, Cohn (*l.c.*, p. 160).

On boiled potato-slices, forming snow-white points and spots.

[11. **M. amyliovorus**, Burrill (*American Naturalist*, xvii., 1883, p. 319).

Cells oval, single or united in pairs, rarely in fours, never in elongated chains, embedded in an abundant mucilage which is very soluble in water,  $1-1.4\ \mu$  long,  $.7\ \mu$  broad; width of a pair  $2\ \mu$ , of four united about  $3\ \mu$ ; movements oscillatory.

In the tissues of plants, causing the so-called "fire-blight" of the pear tree, and similar phenomena in other plants.

Through the action of this organism, the stored starch is destroyed by fermentation, and carbonic acid, butyric acid, and hydrogen are given off. It may be cultivated in pure starch, in water maintained at the temperature of ordinary summer weather.]

## C.—PATHOGENOUS SPECIES.

12. *M. vaccinæ*, Cohn (*l.c.*, p. 161).*Microsphæra vaccinæ*, Cohn.

Cells round, 5–75  $\mu$  in diameter; isolated or united in chains and heaps of two or more, also forming a zoogloea.

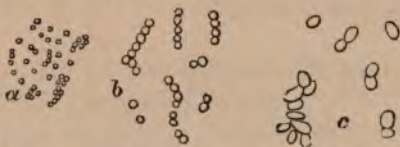


Fig. 4.—*a*, *Micrococcus vaccinæ*; *b*, *M. ureæ* (after Cohn); *c*, *M. ovatus* (after Lebert).

In fresh lymph from cow or human pocks, as also in the pustules of true small-pox.

According to many undoubted investigations, *M. vaccinæ* must be regarded as the active element of vaccine lymph; it is by its means that the infectious principle is conveyed in cases of small-pox. By filtering the lymph, the solid constituents can be separated from the fluid; on using the latter for inoculation, no effect is produced, while inoculation by the former regularly excites the production of pocks. Moreover, that the Micrococci, and not, as might be suggested, the lymph-cells, are the effective constituents of the solid residuum, follows from the fact that lymph which has been exposed to the air for some time grows gradually less effective. For it begins to putrefy, and, as the process of decay advances, the Micrococci disappear more and more, under the influence of the putrefactive Bacteria.

13. *M. diphtheriticus*, Cohn (*l.c.*, p. 162).

Cells oval, 3–1  $\mu$  long; single or concatenate, or forming bundles and colonies of various shapes.

On the so-called diphtheritic membranes, which are found especially on the mucous surfaces of the throat, the pharynx, the air-passages, etc., but also appear on those of the sexual and digestive organs, as well as on wounds, etc.

This Schizomycete is of extraordinarily great pathological importance. For the disease spreads itself, from the centre of its first introduction, through the lymphatic vessels and the tissue which surrounds them,

## 12 *Synopsis of the Bacteria and Yeast Fungi.*

into the connective tissue, the kidneys, and the muscular tissue; and at last reaches even the blood-vessels, where it produces the greatest destruction. The fungi stop up the capillaries and thereby rupture them. Even the thinner bones and cartilage are destroyed by the diphtheritic processes. The consequences of the introduction of these fungi are therefore enormous,

### 14. *M. septicus* (Klebs), Cohn (*l.c.*, p. 164).

*Microsporon septicum*, Klebs.

Cells roundish,  $5\ \mu$  in diameter; united in chains or heaps, or forming a zoogloea.

On wounds, especially in all the affections which are named pyæmia and septicæmia.

In the various suppurations and putrefactions of the body, in decomposition and poisoning of the blood, the Micrococci play an important part. Whether all the manifold phenomena are caused by *M. septicus*, or several species are not rather concerned in their production, is questionable. In wounds, even in the secretion from the fresh surfaces, we find Micrococci, which quickly multiply, produce inflammation and fever, and penetrate deeper and deeper, destroying the tissues in their course. If then they reach the blood-vessels, there arise stoppages and suppurations; the same phenomena are observed in the lungs and the liver.

### 15. *M. bombycis* (Béchamp), Cohn (*l.c.*, p. 165).

*Microzyna bombycis*, Béchamp.

Cells oval,  $5\ \mu$  in diameter; single or in chains. (Fig. 5.)

In the gastric juice and intestines of silkworms, in which they produce the so-called "schlaffsucht" (in French "la flacherie," one of the silkworm diseases), a contagious affection, of which the animals die in a short time.



Fig. 5.—*Micrococcus bombycis*, from the gastric juice of a living silkworm (after Cohn).

[16. **M. insectorum**, Burrill (*L.c.*, p. 319).

Cells obtusely oval, isolated or in pairs, rarely in chains,  $7-1\ \mu$  (usually  $0.8\ \mu$ ) long,  $0.55\ \mu$  broad; movements oscillatory only; forming a zoogloea (?).

In the digestive organs of the chinch-bug (*Blissus leucopterus*).

These insects sometimes die off in great numbers during apparently favourable weather in summer, with every appearance of a contagious disease, and it is probable that this *Micrococcus* is the cause of the disease. It may be cultivated in meat broth.]

[17. **M. gallicidus**, Burrill (*L.c.*, p. 320).

Cells globular, single or in pairs,  $0.5-0.72\ \mu$  in diameter; movements oscillatory only.

In the blood of the domestic fowl affected with "chicken-cholera;" often described, but apparently never named before.]

[18. **M. suis**, Burrill (*L.c.*, p. 320).

*Bacillus suis*, Detmers.

Cells globular, or elongated and more or less contracted in the middle, single or in pairs, rarely in chains,  $0.7-0.8\ \mu$  in diameter.

In the blood and other fluids of pigs affected with "swine-plague" or "hog-cholera."]

Besides the diseases mentioned, it is probable that many others, e.g. cholera, measles, scarlet fever, typhus, syphilis, etc., are caused by Schizomycetous fungi. But no trustworthy observations are yet published concerning them. (See Appendix C.)

[An enormous number of other Micrococci have been described by Eberth, Chalvet, Hallier, etc., but for the most part without names and without precision. (See also *Bacterium*, Chapter IV., *infra*.)]

D.—DOUBTFUL SPECIES.

19. *M. griseus* (Warming).

*Bacterium griseum*, Warming ("Om nogle ved Danmarks Kyster levende Bakterier," p. 29 of the Resumé).

Cells almost round or ovate, colourless,  $2\cdot5$ – $4\ \mu$  long (in the act of division,  $6$ – $7\ \mu$  long),  $1\cdot8$ – $2\cdot5\ \mu$  thick. (Fig. 6.)

In infusions of fresh and sea water.

Since, according to Warming, this form occurs only in a motionless state (and then forming no zoogloea), and since the cell-form answers better to that of the genus *Micrococcus* than to that of *Bacterium*, I have placed it in the former.

Fig. 6.—*Micrococcus griseus*,  $\times 660$  (after Warming).

20. *M. ovatus* (Lebert).

*Panhistophyton ovatum*, Lebert.

*Nosema bombycis*, Nägeli.

Cells oval, about twice as long as broad, rounded at both ends, about  $4$ – $5$ , rarely  $6\ \mu$  long,  $2$ – $3$  (usually  $2\cdot5\ \mu$  broad); isolated or united in pairs or little heaps. (Fig. 4c.)

In various organs of silkworms, their pupæ, and imagos.

It is questionable whether the described cells belong to a Schizomycete. They were first discovered by Cornalia at Milan, and named corpuscules ("corposcoli"); according to him they are found also, although sparingly and more by chance, in the blood of healthy silkworms. Afterwards, these corpuscules ("corpuscules de Cornalia") were recognised as the cause of an epidemic disease of silkworms, called "gattine," or "pébrine."

Since the cells in their form and motionlessness agree very well with *Micrococcus*, I have ranged them here.

[21. **M. toxicatus**, Burrill (*l.c.*, p. 319).

Cells globular, single or in pairs, rarely in chains,  $5\ \mu$  in diameter; movements oscillatory only.

In species of *Rhus* (Sumach), believed to be the peculiar "poison" for which these plants are noted.

Transferred to the human skin, they multiply rapidly, penetrate the epidermis through the sweat-glands (?), and set up the well-known inflammation.]

## II. **ASCOCOCCUS**, Cohn ("Beiträge," i. p. 154).

Cells colourless, very small, round, *united in enormous quantity into* larger or smaller, globular or irregular families. Families often folded, the folds again crimped, *surrounded by a firm, cartilagino-mucous capsule of a rounded form.*

The value of Cohn's genus *Ascococcus* is, in my opinion, just as questionable as that of the similarly named one of Billroth; it is besides doubtful whether or not they are identical. Possibly *Ascococcus* is only a stage in the development of *Micrococcus*.

### 22. **A. Billrothii**, Cohn (*l.c.*, p. 124).

Families lump-like,  $20-160\ \mu$  in diameter, surrounded by a capsule as much as  $15\ \mu$  thick, covering the surface of the fluid in a thick floccose layer. (Fig. 7.)

Forming a membrane on a solution of acid tartrate of ammonia.

The colonies consist of a well-defined cartilagino-mucous colourless envelope, in which either only one or several families are enclosed. The families are of very varied size and form, solid, composed of numerous extremely minute round cells. The Fungus produces in its nutrient fluid a peculiar decomposition; it generates out of the ammoniac tartrate contained therein butyric acid and butyric ether, and changes the originally acid fluid into an alkaline one, while free ammonia is evolved. The liquid has then the characteristic smell of milk or cheese.



Fig. 7.—*Ascococcus Billrothii* (after Cohn). *b*, the investing capsule.

### III. **LEUCONOSTOC**, Van Tieghem (*Ann. Sci. Nat.*, 1873).

[Cells colourless, very minute, globose; *united in flexuose and intertwined chains*, which are *enclosed in thick, lobed, gelatinous sheaths*. Sheaths aggregated into subglobose, brain-like clusters, which present a pseudo-parenchymatous internal structure. Spores isolated in the chains, globose, terminal or intercalary.

This genus is distinguished from *Ascococcus*, in addition to the spores, by the fact that the families are not solid, each chaplet of cells being separated from its neighbours by a thick layer of gelatine. Its analogy to *Nostoc* is remarkable, the main difference being the want of chlorophyll. In fact, it bears the same resemblance to that genus that *Cohnia* does to *Clathrocystis*.]

#### [23. **L. mesenteroides** (Cienkowski), Van Tieghem. *Ascococcus mesenteroides*, Cienkowski.

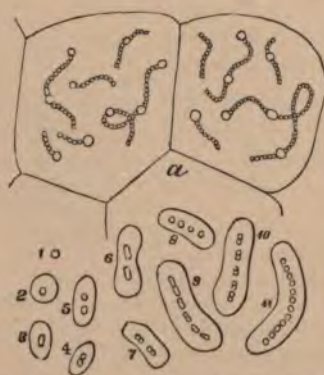


Fig. 8.—*Leuconostoc mesenteroides*,  $\times 520$ .  
a, section of a portion, showing the pseudo-parenchymatous structure, and the intercalary and terminal spores; 1-11, a spore, and its development (after Van Tieghem).

Families collected in large masses, which may measure  $1-1\frac{1}{2}$  inch across or more, polygonal by mutual pressure. Cells in long intertwined chains, colourless, spherical,  $0.8-1.2 \mu$  in diameter; each chain surrounded by a thick gelatinous sheath. Spores spherical, with a thick membrane,  $1.8-2 \mu$  in diameter. (Fig. 8.)

On beet-root sugar, and the sacks, vessels, etc., employed in the

manufacture; can also be cultivated on macerations of dates and carrots, and in the juice of the same, and of beet, and has occurred spontaneously in the sap of turnips and in molasses.

This, the "gomme de sucrerie" of the French, "froschlauch," or frog-spawn, of the German sugar manufacturers, causes a great loss when it is allowed to take hold. It forms large whitish gelatinous masses, which grow very rapidly; the gelatine is elastic, almost cartilaginous, and insoluble in water. It renders acid the originally neutral liquid in which it develops. When a spore germinates, the middle layer of the cell-wall swells up, the spore proper elongates, and divides into two, which separate, and repeat the process. When the development has ceased, certain of the cocci increase in size, thicken their cell-wall, and become changed into spores.—[Tr.]

IV. **COHNIA**, Winter. *Clathrocystis* (Henfrey), Cohn (*pro parte*).

Cells roundish, in a simple peripheral layer surrounded by a common gelatine, forming hollow, round or afterwards irregular bladders or vesicles, which finally are reticulately pierced. Multiplication of the cells by repeated bipartition; of the families by the protuberance and separation of daughter-families.

As I comprehend it, Cohn's genus, *Clathrocystis*, embraces both *Algæ* and *Fungi*. Since, then, the generic name was first used for an *Alga* (*Cl. æruginosa*, Henfrey), it is advisable to leave it for that species, and to make the species which belongs to the *Fungi* the type of a new genus, to which I have given the name of *Cohnia*, in honour of Professor Dr. F. Cohn, of Breslau, who has gained so much distinction in the investigation of the *Schizomycetes*.

24. **C. roseo-persicina** (Kützing).

*Protococcus roseo-persicinus*, Kützing.

*Pleurococcus r.-p.*, Rabenhorst; Cooke, "British Freshwater Algæ," p. 6.

*Microhaloa rosea*, Kützing.

*Bacterium rubescens*, Lankester, *p.p.* (*Quart. Jour.*

*Micr. Sci.*, xiii. 408, pl. 22-3; xv. 206; and xvi. 27, pl. 3).

*Clathrocystis roseo-persicina*, Cohn.

[*Monostroma rosea*, Currey.]

[*Beggiatoa roseo-persicina*, Zopf (*pro parte*).]

Cells round, oval, or, by mutual pressure, polygonal, varying from rose to purple-red, reaching  $2\frac{1}{2} \mu$  in diameter. They form at first small solid families, in which the single cells are bound together by gelatine, while the whole family is surrounded in addition by a gelatinous envelope. Later, the families become larger, globular or ovoid, and finally irregular bodies, which are hollow and filled with a watery fluid, and reach a diameter of  $660 \mu$  ( $= \frac{2}{3}$  mm. or  $\frac{1}{8}$  inch). In these the cells form a simple peripheral layer. These vesicles are often torn or perforated; in the end they present an elegant network, which finally breaks up into irregular rags and tatters. (Fig. 9.)

In marshes, floating on the surface or amongst Algæ and Lemna; often also in a room, in water in which Algæ, etc., are decaying.

The single hitherto known species of this genus is distinguished by its red colouring matter, which is essentially different from that of *Micrococcus prodigiosus*, and is designated "bacterio-purpurin." It is insoluble in water, alcohol, etc., is changed by hot alcohol into a brown substance, and is moreover characterised by its optical behaviour. For in the spectroscope it shows strong absorption in the yellow, less in the green and blue, as well as a darkening in the more refrangible half of the spectrum.\* Each individual cell is surrounded by a dense, almost cartilaginous membrane; its contents are at first homogeneous, but as it grows older one or more dark granules† can be observed in it, which are nothing else but pure eliminated sulphur.

[By the kindness of Mr. J. Levick, then President of the Birmingham

\* For the spectrum, see *Quart. Jour. Micr. Sci.*, xiii. 425.—Tr.

† The granules are the "loculi" of Lankester, and the "spores" of other authors.—Tr.

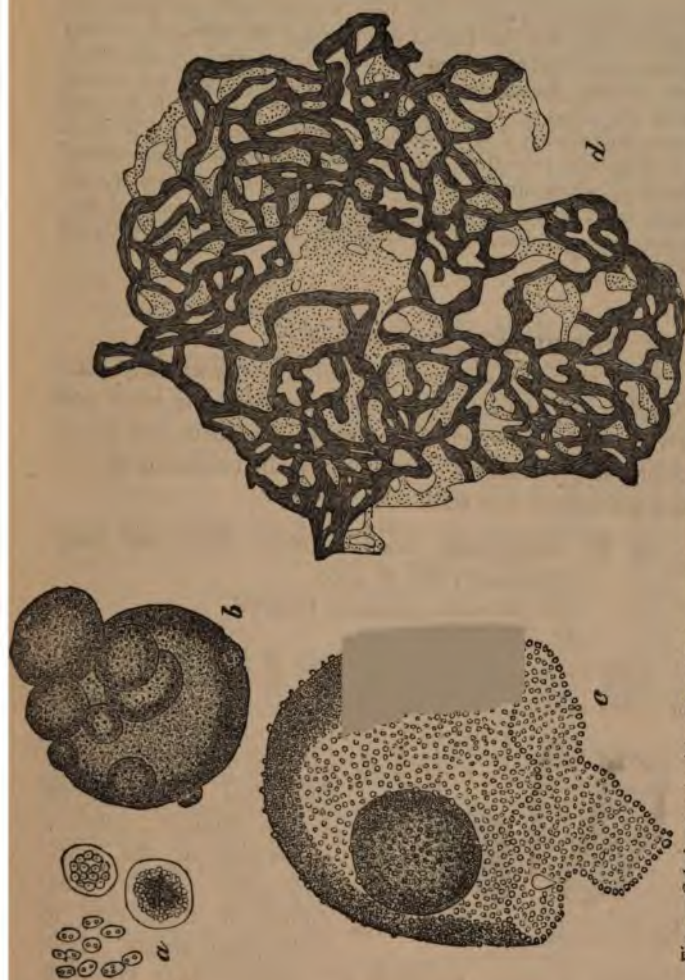


Fig. 9.—*Cohnia roseo-purpurea* (after Cohn). *a*, single cells, often subdividing, afterwards forming families surrounded by gelatine; *b*, an older spherical family; *c*, part of  $\delta \times 300$ ; *d*, an old reticulate family.

## 20 *Synopsis of the Bacteria and Yeast Fungi.*

Natural History Society, I have been favoured with specimens of a supposed Alga from his famous garden pond (the home of so many rarities), which I at once recognized to be this species. It occurred in great quantity, floating freely in the water when young, but sinking among the *débris* at the bottom when old and tattered; its beautiful peach colour renders it very striking among the green Algæ with which it is frequently entangled. It was accompanied by *Monas Okenii*, Ehrenberg, which appears to be identical with *Chromatium Weissii*, Perty; but I could not find any other of the so-called forms of *Bacterium rubescens*, described by Lankester as occurring in company with it.—TR.]

### V. **SARCINA**, Goodsir (*extended*).

Cells roundish, *dividing in two or three dimensions of space*. Daughter-cells connected for some time, forming small solid families or plates, which are often again in their turn united to form larger colonies. Families usually consisting of four or a multiple of four cells.

#### 25. **S. ventriculi**, Goodsir (*Edin. Med. and Surg. Journal*, 1842, p. 430).

*Merismopedia Goodsirii*, Husem,  
*M. ventriculi*, Robin.

Cells roundish, united in groups of four, eight, sixteen, or a few more, flattened at the points of contact, forming

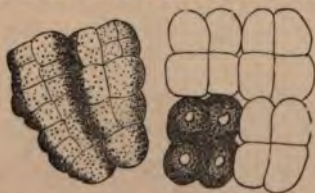


Fig. 10.—*Sarcina ventriculi*,  $\times$  about 1300 (after Lürssen).

little cubes which are rounded off at the corners. Individual cells reaching  $4\ \mu$  in diameter; colonies constricted at the partition walls of the cells, united in their turn to form larger masses. Cell-

contents greenish, yellowish to reddish-brown, not conspicuously refringent. (Fig. 10.)

In the stomach of healthy and diseased persons, and the higher animals; also occurring in other parts of the body, and according to Dr. Ferrier in the blood (*Quart. Jour. Micr. Sci.*, xiii. 163).

26. *S. urinæ*, Welcker.

*Merismopedia urinæ*, Rabenhorst.

Cells very small,  $1.2\ \mu$  in diameter, united in families of from 8 to 64; eight-celled families  $2.3\ \mu$ , 64-celled  $4.5\ \mu$  in diameter.

In the bladder.

27. *S. litoralis* (Oersted).

*Erythroconis litoralis*, Oersted.

*Merismopedia litoralis*, Rabenhorst.

Cells round, or, before division, oval,  $1.2\ \mu$ , seldom 2 or more  $\mu$  in diameter, united into families of four, six, or eight, etc., which in their turn form larger colonies (as many as 64 groups of four in a colony). Plasma colourless, but in each cell from one to four red granules of sulphur. (Fig. 11.)

In putrefying sea-water.



Fig. 11.—*Sarcina litoralis*,  
X 660 (after Warming).

28. *S. Reitenbachii* (Caspary).

*Merismopedium Reitenbachii*, Caspary.

Cells round, before division ovate-elliptical, about  $1.5$ – $2.5\ \mu$  in diameter, at the time of division prolonged to  $4\ \mu$ ; seldom single or in twos and threes, for the most part united in fours or eights, less often in sixteens or more. Cell-walls colourless, lined with a rose-red layer of plasma.

## 22 Synopsis of the Bacteria and Yeast Fungi.

On submerged parts of water-plants, on decaying pieces of the same, and floating free in fresh water.

The families contain at most 32 cells; those consisting of 8 round cells measure  $9.9\ \mu$  in length,  $4.9\ \mu$  in breadth; plates of 8 cells in the act of separating are  $6.6\ \mu$  long,  $4.9\ \mu$  broad; the same of 16 cells have a length of  $16.6\ \mu$ , and a breadth of  $10.7\ \mu$ .

Perhaps also *Merismopedia violacea* (Br  b.), K  tzing, belongs to the Fungi. It agrees closely with *S. Reitenbachii* in size, but is distinguished by its colour, and especially by the fact that the cells are not unfrequently united in one family to as many as 128. Very similar but hitherto, I believe, only found in Sweden, is *Merismopedium chondroideum*, Wittrock.

### 29. *S. hyalina* (K  tzing).

*Merismopedia hyalina*, K  tzing.



Fig. 12.—*Sarcina hyalina*,  $\times 420$  (after K  tzing).

Cells round, almost colourless,  $2.5\ \mu$  in diameter; families usually composed of from 4 to 24 (seldom more) cells, reaching  $15\ \mu$  in diameter. (Fig. 12.)

In marshes.

*Sarcina renis*, Hepworth (*Microscopical Journal*, v., 1857, p. 1, pl.

i. fig. 2), is coloured a lively green, and besides looks very little like a *Sarcina*, and shall therefore only be mentioned.

Besides the foregoing species of *Sarcina*, Fungi belonging to this genus have been observed on various substrata—on cooked potatoes (in little chrome-yellow heaps), on cooked white of egg (in clear yellow spots), also in fluids, even in the blood of healthy and unhealthy persons, and in the mouth.

## VI. BACTERIUM, Cohn ("Beitr  ge," i. p. 168).

Cells *shortly cylindrical, elongated-elliptical or fusiform*, increasing by transverse division, *spontaneously motile*. The daughter-cells either separate from one another *soon* after division, or remain united in a chain of two or more. The formation of a zooglo  a is also frequent. *Spore-formation* like that of *Bacillus*.

## A.—COLOURLESS SPECIES.

30. **B. Termo**, Dujardin ("Zoophyt.," p. 212).*Monas Termo*, Müller.? *Palmella Infusioenum*, Ehrenberg.*Zooglæa Termo*, Cohn.

Cells shortly cylindrical, oblong, about  $1.5-2\ \mu$  long, with a flagellum at each end. (Fig. 13.)

In the most various substances capable of putrefaction, especially in great numbers in macerations of meat, etc. [A supply can be obtained in a few hours by placing a bit of meat in water, at a sufficient temperature.]

*Bacterium Termo* is the ferment of decay; it produces the decay of organic substances, and multiplies

abundantly so long as any putrescible material is present, while it disappears when the decay is completed. It may be obtained with certainty by putting a piece of meat into water, and leaving it to itself, allowing the vessel to stand open in a warm place. In consequence of their enormous power of multiplication, the *Bacterium* cells which are conveyed by the air into the fluid, or which adhere to the meat, form in a short time so numerous a progeny, that even in twenty-four hours the water shows a decided milkiness, which is caused by the Fungus cells floating in it. Moreover that *B. Termo* is the cause of the decay, and does not, as might be supposed, appear secondarily in the decaying substance, is easily shown by a simple experiment. For if the air is allowed to penetrate without hindrance to a putrescible substance, the decay begins very soon, because the air always contains a number of *Bacterium* cells. But if the putrescible organic substance is strongly heated (above  $50^{\circ}\text{C.}$ ) and then protected from the air, it does not



Fig. 13.—*Bacterium Termo*; *b*, the zooglæa form (*a* and *b*, after Cohn,  $\times 650$ ; *c*, after Dalling,  $\times 4000$ ).

putrefy. It might indeed be objected that the air itself or the oxygen thereof causes the decay; but this objection also can be easily refuted. Air may be admitted to easily putrefying substances which have been strongly heated, but be deprived by filtration through cotton-wool of solid bodies (and therefore of Bacterium cells)—and in spite of the admission of air no decay will result.

31. **B. Lineola** (Müller), Cohn (*l.c.*, p. 170).

*Vibrio Lineola*, Müller.

*V. tremulans*, Ehrenberg (*sec.* Cohn!).

*Bacterium triloculare*, Ehrenberg.



Cells exactly similar to those of *B. Termo*, but larger, 3 to 5  $\mu$  long, as much as 1.5  $\mu$  broad, with two flagella at one end.\* (Fig. 14.)

In various infusions, without especial fermentation.

Fig. 14.—*Bacterium Lineola*; *b*, the zoogloea form (*a* and *b*, after Cohn,  $\times 650$ ; *c*, after Dallinger,  $\times 3000$ ).

32. **B. litoreum**, Warming

(*l.c.*, p. 29 of the Resumé).

Cells ellipsoidal or elongated, gradually rounded off at the ends; length 2–6  $\mu$ , breadth 1.2–2.4  $\mu$ ; colourless, motile or stationary, but never united in chains or zoogloea, nor in large heaps. (Fig. 15.)

Only in sea-water.

Fig. 15.—*Bacterium litoreum*,  $\times 660$  (after Warming).

\* [The text says, "mit zwei Geißeln an einem Ende;" but see the figures.—Tr.]

33. *B. fusiforme*, Warming (*l.c.*, p. 30, *Resumé*).

Cells fusiform, with very acute ends, 2-5  $\mu$  long, 5-8  $\mu$  thick, in a spongy layer on the surface of the water. (Fig. 16.)

In sea-water.



Fig. 16.—*Bacterium fusiforme*,  $\times 660$  (after Warming).

34. *B. Navicula*, Reinke et Berthold ("Die Zersetzung der Kartoffel durch Pilze," p. 21).

Cells fusiform or elliptic, narrowed towards both ends, pretty large, partly motile, partly stationary, with one or more dark spots in the interior, which are coloured blue by iodine. (Fig. 17.)

In rotting potatoes.



Fig. 17.—*Bacterium Navicula*,  $\times 940$  (after Reinke and Berthold).

## B.—CHROMOGENOUS SPECIES.

35. *B. synxanthum* (Ehrenberg), Schröter, in Cohn (*l.c.*, p. 120).

*Vibrio synxanthus*, Ehrenberg.

*V. xanthogenus*, Fuchs.

Morphologically not different from *B. Termo*; 7-1  $\mu$  long, moving actively, single or united in chains up to five in number.

Causing the so-called "yellow milk."

Milk, which has been boiled, and some time afterwards coagulated, often suddenly assumes a lemon-yellow colour, while the caseine by degrees nearly disappears. The milk, originally neutral, becomes first acid, and then intensely alkaline. The filtered lemon-yellow fluid becomes amber-coloured on evaporation; the resulting yellow-brown crust is not soluble in alcohol or ether, but completely so in water. Alkalies do not affect the colour, which is instantly changed by acids.

26 *Synopsis of the Bacteria and Yeast Fungi.*

36. **B. syncyanum** (Ehrenberg), Schröter (*l.c.*, p. 124).

*Vibrio syncyanus*, Ehrenberg.

*V. cyanogenus*, Fuchs.

Morphologically the same as the preceding.

Producing the "blue milk."

The colouring matter is changed by potash or soda into a peach-blossom red, while acids restore the original colour. Ammonia, on the contrary, only slightly changes the blue to violet.

37. **B. æruginosum**, Schröter (*l.c.*, p. 122).

In the so-called green or blue pus, which is at times found in wounds, etc. Resembling *B. Termo*.

Even in this case the actively moving Fungus cells are themselves colourless; they secrete the colouring matter, which is verdigris-green, often passing into blue, in the matter which surrounds them.

[38. **B. violaceum** (Bergonzini).

*Chromobacterium violaceum*, Bergonzini (*Ann. Soc. Nat. Moden.*, xiv., 1880; see *Bot. Centralbl.*, i. 1528).

Rods isolated, motile, cylindrical, similar to those of *B. Termo*, 6-1  $\mu$  thick, 2-3  $\mu$  long, of a violet colour.

On solution of white of egg. Pigment insoluble in water, slowly soluble in ether, rapidly in alcohol. The ether dissolves out a red-violet colouring matter, the alcohol a deep blue one.]

VII. **BACILLUS**, Cohn (*l.c.*, p. 173).

Cells *elongated cylindrical*, almost always combined in straight rod-like (*not at all or slightly constricted*) rows or threads, increasing by transverse division. They form a zoogloëa, but often also occur in dense swarms, without the secretion of gelatine. *Reproduction by spores.*

The genus *Bacillus* is very near to *Bacterium*; *Bacterium Lineola* especially is very similar to single *Bacillus* cells. But they can be distinguished by the fact that in the longer *Bacterium* cells self-division has already begun, while in equally long *Bacillus* cells no trace of division can be perceived.

The species are partly always motionless, partly spontaneously motile, passing however at times into a condition of rest. The rod-like cell lengthens itself by intercalary growth to about double its original length, and then breaks up by a transverse division into two daughter-cells, which often separate from one another, often also remain united. Since the products of repeated divisions are arranged end to end, there arise filaments which are often bent in a zigzag fashion, often also straight, apparently unjointed, but the joints may be brought into view by the application of staining materials. The development and germination of the spores in *Bacillus* has been already described. The demarcation of the different species is difficult in this case also.

#### A.—ZYMOGENOUS SPECIES.

##### 39. *B. subtilis* (Ehrenberg), Cohn (*l.c.*, p. 175).

*Vibrio subtilis*, Ehrenberg.

Cells cylindrical, about twice as long as broad, as much as  $6\ \mu$  long, furnished with a flagellum at each end. Usually several united together in pseudo-filaments, which are likewise motile, flexible, and provided with a flagellum at each end. Spore-forming rods three or four times as long as broad, isolated or united in threads. Spores for the most part somewhat thicker than the rods. (Figs. 18, 19, 20a.)

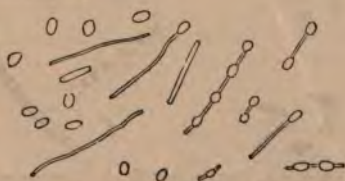


Fig. 18.—*Bacillus subtilis*, with spores (after Cohn).

## 28 *Synopsis of the Bacteria and Yeast Fungi.*

In various infusions and substances ; most probably also in the rennet-stomach of living animals.

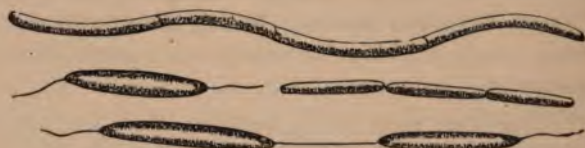


Fig. 19.—*Bacillus subtilis*, X 4000 (after Dallinger).

According to Cohn, it produces the butyric fermentation and is also the efficient cause in the ripening of cheese.

An extraordinary and peculiar power of resistance is possessed by the spores of *B. subtilis* and other species. They are not killed off by boiling, but are thereby excited to speedier germination, which of course brings into consideration the duration of the boiling. A quarter of an hour's boiling does them absolutely no harm, while after an hour most of them, and after two hours all of them are killed. Heating them above 80° C. kills them sooner. They are not affected by poisons and weak acids.

### 40. *B. tremulus*, Koch, in Cohn (*l.c.*, ii. p. 417).

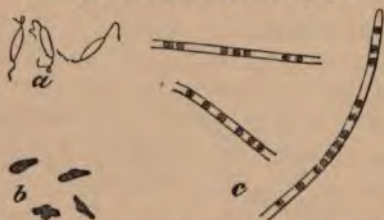


Fig. 20.—*a*, *Bacillus subtilis*; *b*, *B. tremulus*, with spores; *c*, *B. anthracis*, united in threads, forming spores, X 500 (all after photographs by Koch).

Very similar to the preceding, but more slender and usually also shorter, always with a flagellum at each end. Spores conspicuously thicker than the cells, often lateral. (Fig. 20*b*).

On the surface of decaying plant infusions, forming a thick gelatinous membrane.

41. **B. Amylobacter**, Van Tieghem (*Bull. Soc. Bot. France*, xxiv.).

[*Clostridium butyricum*, Prazmowski.]

Morphologically like *B. subtilis*, but distinguished by the fact that at certain times it contains starch in its cells, which can be easily recognised by the blue colour produced on the addition of iodine.

In the cells of laticiferous plants, in decaying plant infusions, etc.

According to Van Tieghem's first communications, this species is the cause of cellulose-fermentation. Afterwards *B. Amylobacter* (and not *B. subtilis*) was indicated by him and Prazmowski (*Bot. Zeitung*, 1879, No. 26) as the ferment of butyric fermentation (*Vibrien butyrique* of Pasteur). According to Prazmowski, *B. Amylobacter* is especially and essentially distinguished from *B. subtilis* by the mode of germination of the spores. The germinating thread in the former species is protruded, not at the equator, but at one of the poles of the sphere. But it appears to me inadvisable to found a new species on this distinction, as Prazmowski desires.

[As little is known about *B. Amylobacter* in England, I append a passage of Van Tieghem concerning it, translated from the *Bulletin* of the Société Botanique de France, 1880, p. 284: "Ordinarily, as we know, when *B. Amylobacter* attacks starch-containing parenchyma, it first dissociates the cells by dissolving their intermediate lamellæ; then it causes the membranes of the cells thus separated to swell up, and dissolves them by degrees, without attacking the granules of starch which they enclose (as in potato, bean, etc.). In *Adoxa Moschatellina* it is quite different. The *Amylobacter* still begins, it is true, by destroying the intermediate lamellæ, and separating the cells, the punctations of which" (he is speaking of the sub-epidermal layer of the rhizome, macerating in water) "are then open to the outside. Penetrating into the cavity by one of these punctations, it proceeds to develop itself there among the starch granules. At the same time it attacks these granules, and causes them by degrees to disappear, without exercising any action upon the cellulose membrane. When it has completely dissolved and absorbed the grains of starch within the cell, the *Amylobacter* forms a brilliant spore in each of its articulations, and disappears. With its membrane unaltered, and the mass of spores which fills it, the cell then fulfils the part of a sporangium." According

30 *Synopsis of the Bacteria and Yeast Fungi.*

to Van Tieghem, it is the action of this saprophyte which causes plant-tissues, immersed in water, to decay. He has even recognised the characteristic traces of its action in the remains of silicified fossil plants of the Carboniferous period; *Ann. Sci. Nat. Bot.*, ix., 1879, p. 381. —Tr.]

42. *B. Ulna*, Cohn (*l.c.*, i. p. 177).

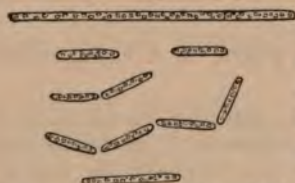


Fig. 21.—*Bacillus Ulna* (after Cohn).

Threads broader than in *B. subtilis*, slightly flexile, with a dense fine-grained plasma. Single cells as much as 10  $\mu$  long, 2  $\mu$  broad. Spores oblong-cylindrical. (Figs. 21, 22.)

In various infusions, *e.g.* of white of egg.

Appears to be scarcely different from *B. subtilis*. Intermediate forms between the two have been observed.



Fig. 22.—*Bacillus Ulna*,  $\times 3000$  (after Dallinger).

B.—PATHOGENOUS SPECIES.

43. *B. anthracis*, Cohn (*l.c.*, p. 177).

Exactly like *B. subtilis*, but motionless and without



Fig. 23.—Development of *Bacillus anthracis* from a spore, and formation of spores in the threads (after Ewart).

flagella; cells  $4\ \mu$  or more long, very slender, for the most part united into long, often bent, threads. Spores not at all or little thicker than the threads,  $1.5\text{--}2.2\ \mu$  long. (Figs. 20c, 23, 24a.)

In the blood of animals which have died of splenic fever; the cause of splenic fever in cattle, sheep, etc., and of "pustula maligna," woolsorters' disease, in man.

*B. anthracis* and the pathological phenomena engendered thereby are the most accurately known of all the diseases induced by Schizomycetes. The Bacilli are found without exception in the blood of animals which have died of splenic fever, and it is sought to infer that they are the cause of the disease. So long as only the vegetative threads were known, it was difficult to prove this; for these are capable of living only a relatively short time, and blood which contains them alone soon loses its power of infection. The remarkable thing about splenic fever, however, is that it often breaks out in a neighbourhood quite suddenly, then disappears for a long time, to appear again just as unexpectedly without any transference from without having taken place. From these facts it must be concluded that the contagium can preserve its infectiveness for a considerable time. The discovery of the spores of *B. anthracis*, which nevertheless are formed only in the blood of dead animals, or when the blood of animals affected with splenic fever is slowly dried, explains this long-lasting power. For, moreover, the spores of *B. anthracis* possess great capabilities of resistance to external influences, especially to dryness, so that they are capable of further development even after years. These spores are buried in the ground with the bodies of diseased animals which have died, and when there means of dispersion are open to them. If then they get in any way into the bodies or the blood of cattle, etc., they germinate, the rods which proceed from them multiply in abundance and soon commence their destructive work.

[This species is now known to move at one stage of its existence,

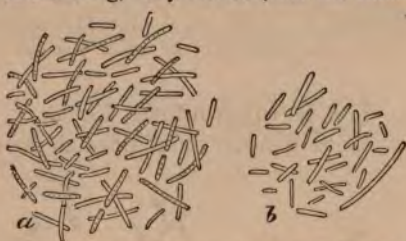


Fig. 24.—a, *Bacillus anthracis*, from the blood of a cow that had died of splenic fever, examined after death; b, *B. ruber*,  $\times 600$  (after Cohn).

## 32 *Synopsis of the Bacteria and Yeast Fungi.*

and also to form a zoogloea (*Quart. Jour. Micr. Sci.*, xviii. 163). Klein describes, *l.c.*, xxiii. 260, a torula-like variety which sometimes passed on the same thread into the typical *Bacillus*.—TR.]

### [44. *B. tuberculosis*, Koch.

Rods slender, about one-half to one-third of a human



Fig. 25.—*Bacillus tuberculosis*, from human sputum, prepared by Heneage Gibbes's method; *a*  $\times 1200$ ; *b*  $\times 1500$ .

red blood-corpuscle in length, *i.e.* 3-4  $\mu$  long, and in breadth one-sixth of their length. Spores not thicker than the threads, about .5  $\mu$  in diameter. (Fig. 25.)

In the walls of tuberculous cavities, in the sputum, and even in the breath of phthisical patients, in degenerated scrofulous glands, in fungous joints, and in the bones of tuberculous animals (Koch), and in all kinds of tuberculous new formations (neoplasms).

This was first discovered by Koch, by staining with methylene blue in alcohol, followed by a solution of vesuvin; the methods of Ehrlich, Baumgarten, and Heneage Gibbes are given in the Appendix, p. 103.]

### [45. *B. lepræ*, Hansen (Virchow, *Archiv*, 1880, p. 32).

Rods slender, resembling those of *B. tuberculosis*, but about .7  $\mu$  broad. Spores not thicker than the threads. (Fig. 26.)

In the "lepra" formations of the skin, in the liver, the spleen, the testicles, the lymph-glands, the mucous membrane of the mouth, throat, etc., of leprous patients,

but, as it appears, not in the kidneys or the blood. The "brown elements" always found in old tubercles are pro-

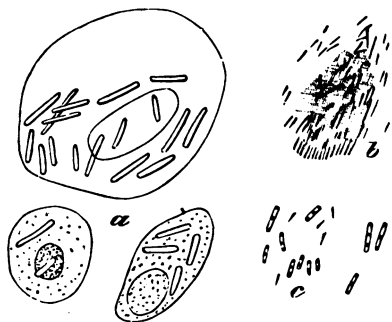


Fig. 26.—*Bacillus lepræ*. *a*, cells from tubercles, fresh; *b*, a "brown element" coloured with methyl-violet, from a tubercle treated with osmic acid; *c*, bacilli, with spores (*a* and *b*, after Hansen; *c*, after Neisser).

bably agglomerations of spores and spore-forming Bacilli. This species is acted upon by staining agents in the same way as *B. tuberculosis*.]

### C.—CHROMOGENOUS SPECIES.

#### 46. *B. ruber*, Frank et Cohn (*l.c.*, i. p. 181).

Rods 6–8  $\mu$  thick, scarcely 1  $\mu$  thick, actively motile, isolated or united from two to four together. Dividing rods sometimes shorter, only 3–4  $\mu$  long. Secreting a brick-red pigment, which is different from that of *M. prodigiosus*. (Fig. 24.)

On boiled rice.

#### 47. *B. erythrosporus*, Cohn (*l.c.*, iii. p. 128).

Motile, short, slender rods, partly forming longer threads,

34 *Synopsis of the Bacteria and Yeast Fungi.*

in which numerous oval-oblong, bright shining, dirty red-coloured spores arise. (Fig. 27.)

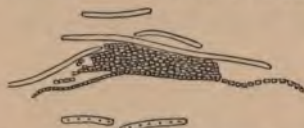


Fig. 27.—*Bacillus erythrosporus* (after Miflet).

On a solution of extract of meat, putrefying infusions of white of egg, and putrefying macerations of meat.

This species forms partly little floating scales, partly continuous membranes; the threads finally dissolve to a jelly, thereby freeing the spores, which then sink to the bottom, united in little gelatinous heaps. The species is easily recognisable by the dirty-red colour of the spores.

VIII. **LEPTOTHRIX**, Kützing (*"Phycologia Generalis,"* p. 198), *pro parte*.

Threads very long and slender, *unbranched*, apparently inarticulate, colourless, *without motion*, *not granular*, free or felted together.

The Fungi assigned to the genus *Leptothrix* are of very questionable value as species; I therefore include the following with all reserve. *Leptothrix*-like formations are very common in *Bacillus*.

Since this genus will probably remain only a short time among the Fungi, I do not think it desirable to give it a new name now. The greater part of the species of *Leptothrix* are typical phycochromeaceous Algae!

48. **L. buccalis**, Robin (*"Hist. Nat. Vég. Paras.,"* p. 345).

Threads very long and slender,  $7-1\ \mu$  (seldom somewhat more) thick, inarticulate, colourless, densely felted in white masses. (See also Fig. 27a.)

Mixed with Micrococci (usually also with *Vibrio*, etc.) in

the white slime of the teeth, on the epithelium of the mouth, and in hollow teeth ; probably the cause of dental caries.

The seat of this Fungus is especially in the canals of the dentine, yet it also attacks the substance of the enamel, which it destroys by degrees. In those canals the Fungus produces decided enlargements, and afterwards their walls become pierced by crevices and fissures, and break to pieces. [According to recent authors, the enamel must first be attacked by the acids of the mouth, before the Fungus can effect a lodgment.]

49. *L. parasitica*, Kützing (*Bot. Zeit.*, 1847, p. 220).

Threads very slender, for the most part curled and crisped, indistinctly jointed, loosely felted, almost colourless, about  $1\ \mu$  thick, 100–140  $\mu$  long. (Fig. 28.)

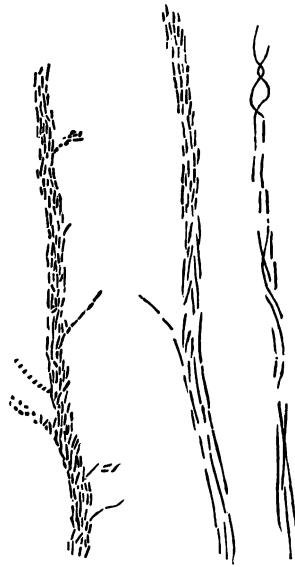


Fig. 27a.—*Leptothrix buccalis* (after Zopf). This is the form called *Zooglaea ramigera*.

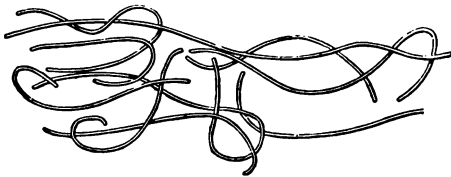


Fig. 28.—*Leptothrix parasitica*,  $\times 600$  (after Kützing).

Parasitic on Scytonemaceæ and other allied Algæ.

Perhaps also *Leptothrix pusilla*, Rabenhorst, and *L. Lanugo*, Kützing, should be placed among the Fungi.

In sulphur springs.

In Wartmann and Schenk's "Schweiz. Kryptog.," No. 639, this species is published under the name of *Symphyothrix nivea*, Brügger. Both the names given above are cited as synonyms, but only *pro parte*. From the label attached I extract the following observations:—"Threads inarticulate and motionless, only  $\frac{1}{1000}$  to  $\frac{1}{1000}$ " thick ( $= 5-1.3 \mu$ ), parallel and much entangled, in penicillate tufts, strings, and sheaves of very unequal size, which are surrounded by a common, homogeneous, colourless gelatine."

52. *B. leptomitiformis* (Meneghini), Trevisan ("Flor. Eug.," p. 56).

*Oscillaria leptomitiformis*, Meneghini.

Threads very slender, indistinctly jointed, about  $1.8-2.5 \mu$  thick, forming a thin chalk-white slimy layer. (Fig. 29c.)

In sulphur springs.

53. *B. arachnoidea* (Agardh), Rabenhorst ("Flor. Eur. Alg.," ii. p. 94).

*Oscillaria arachnoidea*, Agardh.

*O. versatilis*, Kützing.

Threads pretty thick, distinctly jointed, strongly motile, with rounded slightly curved ends. Articulations as long or half as long as broad. Threads  $5-6.5 \mu$  thick, forming thin, arachnoid, chalk-white gelatinous membranes. (Fig. 31.)

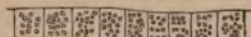


Fig. 31.—*Beggiatoa arachnoidea*,  $\times 320$  (after Warming).

In sulphur springs and marshes.

54. *B. pellucida*, Cohn (*Hedwigia*, 1865, p. 82).

Threads about  $5 \mu$  thick, motile, distinctly jointed, with rounded ends; articulations almost as long as broad, translucent, containing but few granules. (Fig. 32.)

In an aquarium with sea-water.

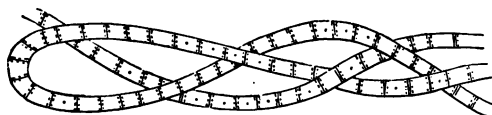


Fig. 32.—*Beggiatoa pellucida*,  $\times 400$  (after Cohn).

55. **B. mirabilis**, Cohn (*l.c.*, p. 81).

Threads very thick, motile, bent and curled in various ways, with rounded ends, distinctly jointed, as much as  $16\ \mu$  thick; articulations about half as long as broad, filled with numerous, pretty large granules. Threads twisted round and entangled with one another, forming a snow-white web of gelatinous threads. (Fig. 33.)

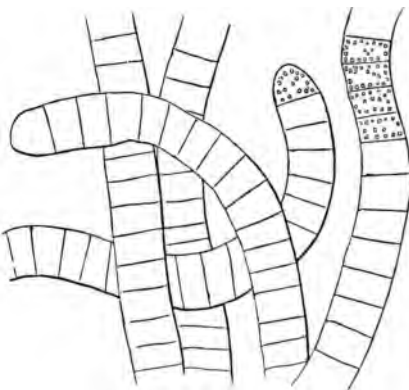


Fig. 33.—*Beggiatoa mirabilis*,  $\times$  about 320 (after Cohn).

With the preceding.

DOUBTFUL SPECIES.

56. **B. tigrina**, Rabenhorst ("Flor. Eur. Alg.," ii. p. 95).

*Oscillaria tigrina*, Römer.

Threads pretty thick, oscillating, distinctly jointed, with blunt and slightly bent, sometimes abruptly attenuated and crooked ends, translucent,  $3.5-4.5\ \mu$  thick; forming thin white layers. (Fig. 29*d*.)

In marshes and on wood under water.

57. **B. minima**, Warming (*l.c.*, Resumé, p. 15).

Very minute, actively motile and flexible. The longest specimens about  $40\ \mu$  long,  $1.8-2\ \mu$  thick; articulations discernible in the form of delicate transverse bars. Each joint about half as long as broad. Without granules.



Fig. 34.—*Beggiatoa minima*,  $\times 660$  (after Warming).

(Fig. 34.)

In sea-water.

X. **CLADOTHRIX**, Cohn ("Beiträge," i. p. 204).

Threads like those of *Leptothrix*, very slender, colourless, not articulated, straight or slightly undulated, or even in places twisted in irregular spirals, *with false branching*.

I can discover no sufficient distinction between *Cladotrix* and *Streptothrix*. Both are very doubtful genera.

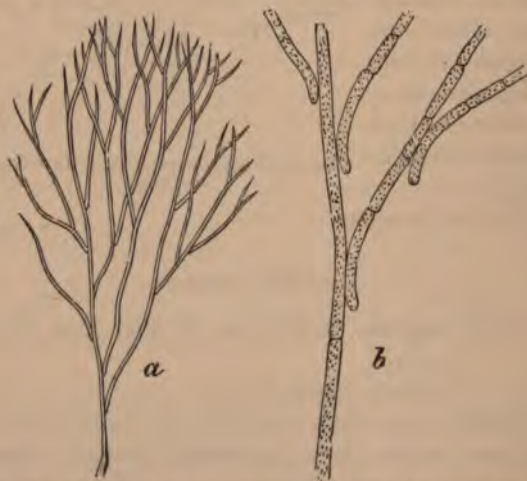


Fig. 35.—*a*, *Cladotrix dichotoma*,  $\times 100$ ; *b*, a part of the same, showing the false dichotomy,  $\times 600$  (after Cohn).

58. *C. dichotoma*, Cohn ("Beiträge," i. p. 185).

Threads repeatedly and regularly dichotomously branched, straight or slightly bent, about  $3\ \mu$  thick, forming small tufts of  $\frac{1}{4}$  or more mm. in diameter. (Fig. 35.)

In putrid water, partly floating on the surface, partly attached to Algæ.

The branching is here, just as with *C. Försteri*, only apparent. A thread splits itself down the middle into two halves, which lengthen independently, and thus grow side by side, whereby the piece which was separated is pressed on one side, and so appears as a branch.

59. *C. Försteri* (Cohn.)

*Streptothrix Försteri*, Cohn  
("Beiträge,"  
i. p. 186).

Threads straight or bent, in places twisted in irregular spirals, sparingly and irregularly branched, separating into pieces of various lengths. (Fig. 36.)

In the lachrymal canals of the human eye, forming tallowy or crumbling masses, which are yellowish-white or blackish,  $1\frac{1}{2}$ –3''' long, and about 1''' (i.e. about 2 mm.) thick.

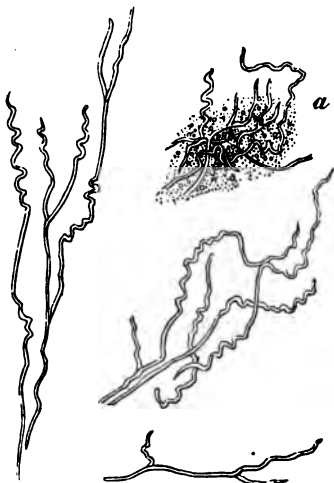


Fig. 36.—*Cladothrix Försteri*,  $\times 600$ . a, the threads embedded amongst Micrococci (after Cohn).

XI. *MYCONOSTOC*, Cohn ("Beiträge," i. p. 183).

Threads very slender, colourless, inarticulate, but on desiccation breaking up into short cylindrical fragments,

42 *Synopsis of the Bacteria and Yeast Fungi.*

variously bent and intertwined, surrounded by gelatine, which forms spheroidal masses of 10-17  $\mu$  (or more) in diameter. Multiplication by constriction and bipartition of these gelatinous masses.

60. *M. gregarium*, Cohn (*l.c.*).

Gelatinous masses floating on the surface of putrid water, singly or heaped into little slimy drops; exterior boundary sharply defined. (Fig. 37.)

On water in which Algæ were decaying.

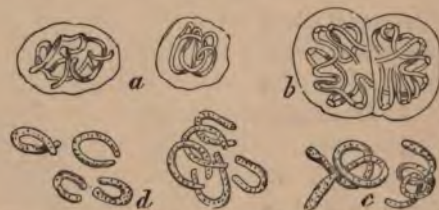


Fig. 37.—*Myconostoc gregarium*. a, gelatinous spheroids, containing the threads; b, a spheroid in the act of division; c, the threads separated; d, the threads breaking up into ring-shaped pieces (after Cohn).

[This species was recorded by Professor Lankester as a phase of *Spirillum Undula* (*Quart. Jour. Micr. Sci.*, xiii. 424), but as no genetic connection between the two has yet been traced, Cohn thinks it better, at present, to keep it distinct. It derives its name from its resemblance to Nostoc among the Algæ. (Fig. 38.)—TR.]



Fig. 38.—*Myconostoc gregarium*,  $\times 1500$  (after Lankester, who considers it a zoogloea form of *Spirillum Undula*).

XII. **SPIROCHÆTA**, Ehrenberg (*Abhandl. Berlin. Akad.*, 1833, p. 313).

Cells united in long slender threads, which present a considerable number of close spiral turns. The threads are very actively motile; in fact they swim forwards or backwards, rotating round their longitudinal axes, and can moreover bend themselves in the most varied manner. Not forming a zoogloea, but often felted in dense tufts.

Distinguished from *Spirillum* by the long, closely wound, flexible threads.

61. **S. plicatilis**, Ehrenberg (*l.c.*, p. 313).

*Spirillum plicatile*, Dujardin.

*Spirulina plicatilis*, Cohn.

Threads very short and slender, with numerous close spirals, articulated, blunt at the ends, 110–225  $\mu$  long (according to Rabenhorst); diameter of the single joints (and thickness of the threads) 2.25  $\mu$ , according to Ehrenberg. [Spores, according to Van Tieghem, 8  $\mu$  in diameter.] (Fig. 39.)

In bog-water, among Algæ.

This species is said by Koch to be distinguished from the others especially by the doubly undulated contour of its filaments. But still filaments with a simple spiral are very abundant. [Dr. Klein (*Quart. Jour. Micr. Sci.*, xv. 382) asserts that he has seen all intermediate forms between this and *Spirillum tenue*, with which he unites it.—TR.]

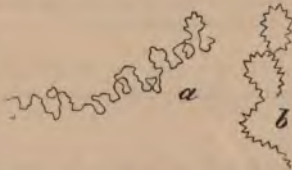


Fig. 39.—*Spirochæta plicatilis* (a, after a photograph by Koch; b, after Cohn).

62. **S. Obermeieri**, Cohn ("Beiträge," i. p. 196).

Morphologically almost the same as *S. plicatilis*, perhaps

#### 44 *Synopsis of the Bacteria and Yeast Fungi.*

only distinguished by the fact that the threads are pointed at both ends. (Fig. 40.)



Fig. 40.—*Spirochæta Obermeieri* (c, after a photograph by Koch; d, after Weigert). In d the blood corpuscles are represented; the bent threads show the form assumed shortly before the cessation of the fever.

In the blood of persons suffering from *febris recurrens*, and probably the cause of the disease.

The threads of *S. Obermeieri* are either extended in a straight line, and wound in regular spirals, or else they bend themselves, moving with extreme rapidity in the most varied fashion, so that the spirals appear of unequal size, especially at the most strongly bent places. This species is found in the blood of those suffering from intermittent fever, and in fact only during the recurring fever periods, or for a short time thereafter. In the intervals of freedom from fever they disappear.

[It is a question whether this be not the same as the preceding species, merely transplanted into a different habitat.—Tr.]

#### 63. *S. Cohnii*, Winter ("Pilze," i. p. 61, 1884).

[*Spirochæte denticola*, Arndt.]

[*S. dentium*, Miller.]

Very similar to both the foregoing species, but always shorter, and for the most part more slender, than *S. Obermeieri*, and besides, like that, pointed at both ends. (Fig. 41.)

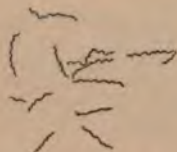


Fig. 41. — *Spirochæta Cohnii* (after Koch).

In the slime of the teeth; discovered by Cohn; figured by Koch ("Beiträge zur Biologie," vol. ii. pt. 3, pl. xiv. fig. 8). [Miller has shown that this is articulated, like *S. plicatilis*.]

64. *S. gigantea*, Warming (*l.c.*, Resumé, p. 21).

Threads cylindrical, blunt at both ends, about  $3\ \mu$  thick, with numerous spiral turns, the height of which is  $25\ \mu$ , the diameter  $7-9\ \mu$ . Flexile. The articulations are not



Fig. 42.—*Spirocheta gigantea*; *a*,  $\times 166$ ; *b*,  $\times 660$  (after Warming).

visible, but at times the threads break up into joints. Colour greyish. (Fig. 42.)

In sea-water.

The longest specimens showed sixteen turns; flagella have not been discovered.

XIII. **SPIROMONAS**, Perty ("Zur Kenntniss der kleinsten Lebensformen," p. 171).

Threads "*flattened like a leaf, twisted round an imaginary longitudinal axis.*" Multiplication by transverse division.

65. *S. volubilis*, Perty (*l.c.*).

"Colourless, translucent [rounded at both ends], smooth, without any obvious differentiation, motion pretty swift, combined with a quick revolution round the axis about which the leaf-like body is twisted. Body often twisted very little, never forming more than a circumference. Length  $\frac{1}{120} - \frac{1}{180}$ ''' =  $15-18\ \mu$ ." (Fig. 43.)



Fig. 43.—*Spiromonas volubilis*,  $\times$  about 450 (after Perty).

46 *Synopsis of the Bacteria and Yeast Fungi.*

In stagnant bog-water and putrefying infusions.

[This is often considered as an Infusorian. See Saville Kent's "Manual of the Infusoria," p. 298.—Tr.]

66. **S. Cohnii**, Warming (*l.c.*, Resumé, p. 20).

Cells flattened, but sometimes slightly angular, acutely pointed at both ends, each with one flagellum, with  $1\frac{1}{4}$  (seldom more) turn. Spiral elongated, 6-9 times as high as its diameter, 9-20  $\mu$  in height, 1.2-3.5  $\mu$  in diameter. Breadth of the cells 1.2-4  $\mu$ . Colourless, often with one or two longitudinal striations. (Fig. 44.)



Fig. 44.—*Spiromonas Cohnii*,  $\times 660$  (after Warming).

In stinking, very much decomposed water.

XIV. **SPIRILLUM**, Ehrenberg (*Abhandl. Berlin. Akad.*, 1830, p. 38).

(*Vibrio*, Cohn; *Ophidomonas*, Ehrenberg.)

Cells cylindrical or slightly compressed, simply *arcuate* or *spirally twisted*, *rigid*, with a flagellum at each end (? whether in all species). Multiplication by transverse division, the daughter-cells for the most part soon separating. At times also a zoogloëa is formed. Spore-formation similar to that of *Bacillus*.

I unite with the genus *Spirillum*, the *Vibrio* of Cohn, and the *Ophidomonas* of Ehrenberg. The genus *Vibrio*, in fact, cannot be sharply defined, since flagella have also been found in it. Cohn himself has already united *Ophidomonas* with *Spirillum*. Warming also combines all three genera. Although the name *Vibrio* has priority, still I have preferred the designation *Spirillum*, because gross misuse has been made of the former, especially by non-botanists, so that it is better to let it lapse altogether.

67. *S. Rugula* (Müller).*Vibrio Rugula*, Müller ("Infus.," p. 44).*Melanella flexuosa*, Bory.

Cells 6–16  $\mu$  long, about 5–2.5  $\mu$  thick, either only simply arcuate, or with one shallow spiral, bearing a flagellum at each end; actively rotating round its longitudinal axis; the cells are often felted in dense swarms. Height of the spiral generally 6–10  $\mu$ , diameter 5–2  $\mu$ . Spores always at the end of the cell, globose. (Fig. 45*a*.)

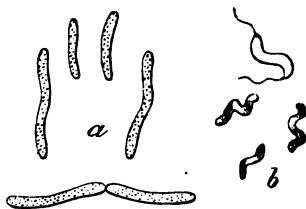


Fig. 45.—*a*, *Spirillum Rugula*; *b*, *S. Undula* (*a*, after Cohn; *b*, after Koch's photographs).

In bog-water, and various infusions; also in the slime of the teeth, etc.

According to Warming, individuals occur the spiral of which reaches a height of 13–20  $\mu$  and a diameter of 2.5–5  $\mu$ . Plasma granular.

68. *S. serpens* (Müller).*Vibrio serpens*, Müller ("Infus.," p. 44).

Cells half as broad as in the foregoing species, 11–28  $\mu$  long (according to Rabenhorst), 8–1.1  $\mu$  thick, with several, usually three or four, spirals; often united in long chains; with a flagellum at each end. Also frequently forming swarms. Height of the spirals 8–12  $\mu$ , diameter 1.2–3  $\mu$ . (Fig. 46 *a*, *b*.)

In various infusions.

The dimensions recorded by Rabenhorst (23–28  $\mu$  long) presumably refer to threads composed of several cells. According to Warming, the height of the spirals is sometimes as much as 22  $\mu$ .

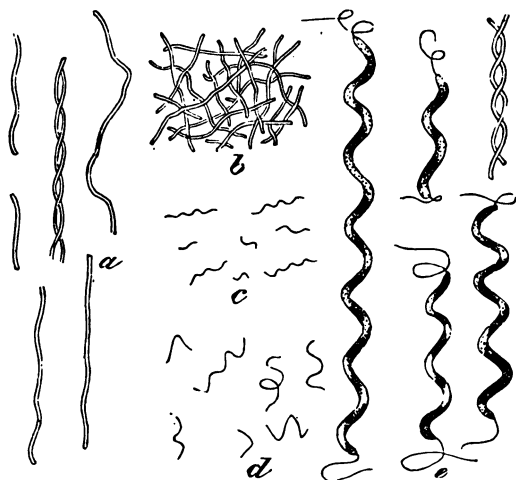


Fig. 46.—*a*, *Spirillum serpens*; *b*, the same, felted in a "swarm;" *c*, *S. tenue*; *d*, *S. Undula*; *e*, *S. volutans*,  $\times 650$  (after Cohn).

69. ***S. tenue***, Ehrenberg ("Die Infusionsthierchen," p. 84).

Cells very slender,  $4-15\ \mu$  long, about  $2.25\ \mu$  thick (according to Ehrenberg), with at least  $1\frac{1}{2}$ , usually, however, 2, 3, 4, or 5 spirals. Height and diameter of the spirals about  $1.5-4\ \mu$ , or the diameter amounts to half the height. Moving very swiftly, but also often almost motionless and felted in dense swarms or masses, or united in a zooglœa. (Figs. 46*c*, 47.)

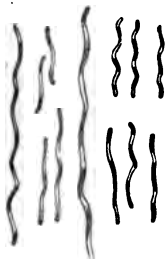


Fig. 47.—*Spirillum tenue*,  $\times 660$  (after Warming).

In various infusions.

According to Warming, only  $1\ \mu$  thick, and the spirals at times  $8-10\ \mu$  high, with the diameter  $\frac{1}{4}-\frac{1}{5}$  of the height. There appears to be some confusion between *S. tenue* and *S. Undula*.

70. *S. Undula* (Müller), Ehrenberg (*Abhandl. Berlin.*

*Akad.*, 1830, p. 38).

*Vibrio Undula*, Müller.

*V. prolifer*, Ehrenberg.

Cells 8-12  $\mu$  long, 1.1-1.4  $\mu$  thick (according to Rabenhorst); spirals wider than in the foregoing, 4-5  $\mu$  high; each cell for the most part embracing only  $\frac{1}{2}$  or 1, seldom



Fig. 48.—*Spirillum Undula*,  $\times 3000$  (after Dallinger).

1 $\frac{1}{2}$  to 2 or 3 spirals; a flagellum at each end. Very actively motile, at times also forming a zoogloea. (Figs. 45*b*, 46*d*, 48.)

In bog-water and various infusions.

Ehrenberg gives for *S. tenue* a thickness of  $\frac{1}{1000}$  of a line, for *S. Undula* only  $\frac{1}{1000}$  of a line; at the same time, he says in the description, "Sp. fibris valde tortuosis brevibus, validioribus."

According to Warming, *S. Undula* is more variable than was formerly admitted. The spirals are often elongated, so that the cell appears almost straight; accordingly the height of the spirals varies from 3 to 10.5  $\mu$ , the diameter amounts to  $\frac{3}{4}$ , or  $\frac{1}{10}$  of the height, the thickness of the cells .6-1.3  $\mu$ .

Var. *litorale*, Warming (*l.c.*, Resumé, p. 23).



Fig. 49.—*Spirillum Undula*, var. *litorale*,  $\times 660$  (after Warming).

50 *Synopsis of the Bacteria and Yeast Fungi.*

As much as  $3\ \mu$  thick, spirals elongated, each  $5-10\ \mu$  high, diameter  $\frac{1}{2}$  or  $\frac{1}{3}$  of the height. (Fig. 49.)

On the shores of the Baltic Sea.

[71. *S. amyliiferum*, Van Teighem (*Bull. Soc. Bot. France*, 1879, p. 66).

Motile. Spiral of 2-4 turns, diameter of spiral  $3-4\ \mu$ , height  $6-9\ \mu$ . Thickness of thread  $1.2-1.5\ \mu$ . At each end a delicate flagellum. When growth has ceased, the contents become amylaceous, so as to be coloured blue by iodine, except at one place in each cell, where a spore is afterwards formed. Spores oval, strongly refringent,  $2.5-3\ \mu$  long,  $1.5\ \mu$  broad.

Each turn of the spiral is usually occupied by one cell, and forms one spore. When the spiral has grown to four turns, two lateral septa are formed, and the four cells separate into two equal portions, by the solution of the intermediate layer of the median partition. While in active growth the cell-contents are coloured yellow by iodine. The spores are always placed at the end of a cell. In germinating, they throw out a tube, which soon becomes curved, and then spiral. When it has taken two turns, a central partition is formed. The similarity of this to the formation and germination of a Bacillus spore is noticeable; *S. amyliiferum* is most probably only a phase of *B. Amylobacter*, in company with which it was found.]

72. *S. volutans*, Ehrenberg (*Abhandl.*, 1830, p. 38).

*Vibrio Spirillum*, Müller.

*Melanella Spirillum*, Bory.

Cells slightly attenuated towards the ends, gently rounded,  $25-30\ \mu$  long, about  $1.5-2\ \mu$  thick; each cell with  $2\frac{1}{2}-3\frac{1}{2}$  (seldom more) spirals, the spiral  $9-13\ \mu$  high,  $6.5\ \mu$  in diameter; a flagellum at each end. (Fig. 46e.)

In various infusions, as well as in bog-water among Algæ.

According to Warming, the spirals are often elongated, so that the cell appears almost straight; the diameter then amounts to only  $1.5-4\ \mu$ .

Var. *robustum*, Warming (*l.c.*, Resumé, p. 23).

Thickness  $2-4.5 \mu$ , height of the spirals  $10-20 \mu$ , diameter  $1-3 \mu$ . Usually with  $1\frac{1}{2}$  turn. Sometimes with two flagella at one end. (Fig. 50.)

In sea-water.



Fig. 50.—*Spirillum volutans*, var. *robustum*,  $\times 660$  (after Warming).



Fig. 51.—*Spirillum sanguineum*,  $\times 600$  (after Koch).

73. *S. sanguineum* (Ehrenberg), Cohn ("Beiträge," i. p. 171).

*Ophidomonas sanguinea*, Ehrenberg.

Cells cylindrical, only seldom attenuated at the ends,  $3 \mu$  or more thick, of various lengths, with usually 2 (seldom  $\frac{1}{2}$  or  $2\frac{1}{2}$ ) spirals. Height of the spirals  $9-12 \mu$ , diameter about  $\frac{2}{3}$  of the height; a flagellum at each end. Cell-contents coloured by numerous reddish bodies, with many sulphur granules. (Fig. 51.)

In putrefying brackish water [and pond water?].

According to Warming, the longest specimens reach  $65 \mu$ ; the height of the spirals  $15-37 \mu$ , while the diameter amounts to  $\frac{1}{4}$  or  $\frac{3}{8}$ , or in small specimens  $\frac{1}{4}-\frac{1}{14}$  of the height.

[According to Saville Kent, the *Ophidomonas sanguinea* of Ehrenberg is a true monad, and not identical with Cohn's *Spirillum sanguineum*. (See "Manual of the Infusoria," p. 244, and *infra*, p. 94.)—TR.]

74. *S. violaceum*, Warming (*l.c.*, Resumé, p. 5).



Fig. 52.—*Spirillum violaceum*,  $\times 660$  (after Warming).

Cells either crescent-shaped (and so without a complete turn) or with 1 or  $1\frac{1}{2}$  spiral, broadly rounded at the ends, with a flagellum at each. Cell-contents violet, with a few sulphur granules. Height of the spiral 8–10  $\mu$ , diameter 1–1.5  $\mu$ , thickness of the cells 3–4  $\mu$ . (Fig. 52.)

In brackish water.

75. *S. Rosenbergii*, Warming (*l.c.*, Resumé, p. 11).



Fig. 53.—*Spirillum Rosenbergii*,  $\times 660$  (after Warming).

Cells with 1 or  $1\frac{1}{2}$  turn, 4–12  $\mu$  long, 1.5–2.6  $\mu$  thick, colourless, but with extremely numerous strongly refringent sulphur granules. Spirals 6–7.5  $\mu$  high, of very varied diameter, which amounts at the most to half of the height. Moving actively and in the most varied fashion, but, as it seems, without flagella. (Fig. 53.)

In brackish water.

76. *S. attenuatum*, Warming (*l.c.*, Resumé, p. 25).



Fig. 54.—*Spirillum attenuatum*,  $\times 660$  (after Warming).

Cells strongly attenuated at the ends, usually with 3 spirals. The middle spiral is large and close (height about 11  $\mu$ , diameter 6  $\mu$ ), the end spirals are elongated (10  $\mu$  high, 2  $\mu$  in diameter). Thickness of the cells 2 or 1.2  $\mu$ . (Fig. 54.)

In sea-water.

77. *S. Jenense* (Ehrenberg).

*Ophidomonas Jenensis*, Ehrenberg ("Infusions-thierchen," p. 44)

Cells obtuse at both ends, with flagella, olive-brown,  $40\ \mu$  long, about  $3\frac{1}{3}\ \mu$  thick, with  $\frac{1}{2}$ – $2\frac{1}{2}$  spirals. (Fig. 55.)



Fig. 55.—*Spirillum Jenense*,  $\times 600$  (after Ehrenberg).

Whether this is really a distinct species is hard to say, so long as it is not found again in the original locality. Possibly it is identical with *S. volutans*.

[Saville Kent classes this as a true monad (see "Manual of the Infusoria," p. 244). Warming thinks it may be identical with *O. sanguinea*.—Tr.]

APPENDIX.

With the Schizomycetes we may range several other genera which are partly united with them by others without remark, but which present so great peculiarities that it will be better provisionally to separate them.

XV. **SPHÆROTILUS**, Kützing.

Cells roundish-angular or oblong, rounded at the corners, united in great numbers in a colourless gelatinous sheath to form long threads, which are densely tufted and entangled in floating flakes. Multiplication by means of vegetative cells, which isolate themselves and then form new threads by continued subdivision. Reproduction by spores, which are produced endogenously within the vegetative cells.

78. *S. natans*, Kützing (*Linnæa*, 1833, p. 385).

Flakes in the vegetative stage yellow-brown in the

## 54 *Synopsis of the Bacteria and Yeast Fungi.*

older parts, colourless in the younger, many times branched, very slimy. During spore-formation, partly milk-white, partly red-coloured. Cells  $4-9\ \mu$  long,  $3\ \mu$  thick. (Fig. 56.)

In stagnant and flowing water.

The flakes consist of an enormous mass of long, variously combined threads, which are formed of rows of cells, surrounded by a slimy,



Fig. 56.—*Sphaerotilus natans* (after Kützing).

evanescent sheath. These threads often assume a shrubby branched form, and are attached to water-plants, or float in a thin layer on the water. In the formation of spores, the protoplasm of the cells breaks up into numerous minute, strongly refringent portions, which become round spores, red at maturity, afterwards of a brown colour. These are set free by the dissolution of the mother-cell. They germinate very quickly, and grow into threads which are either isolated, or united with the parent-threads or with other threads as well. These daughter-threads, proceeding from the germinating spore, are at first undivided; not till after a time do they break up into the typical rows of cells. Sometimes the growth of the spores into threads takes place while they are still within the mother-cell.

*Sphaerotilus ochraceus*, de Brébiss in litt., Kützing, "Species Algarum," p. 147, does not belong to this genus.

### XVI. **CRENOTHRIX**, Cohn.

Threads cylindrical, somewhat clavately thickened upwards, articulated, provided with a sheath. Multiplication by means of the joints, which escape from the sheath and grow into threads. Reproduction by spores, which are formed in the sheath by further subdivision of the joint-cells. The spores either grow directly into threads, or form by continued subdivision gelatinous colonies of roundish cells, which afterwards produce threads.

79. **C. Kühniana** (Rabenhorst), Zopf ("Untersuch. über Cren." (1879), p. 3).

*Leptothrix Kühniana*, Rabenhorst.

*Hypheothrix Kühniana*, Rabenhorst.

*Crenothrix polyspora*, Cohn.

? *Palmellina flocculosa*, Radlkofer.

Threads in whitish or brownish tufts, 1.5–5  $\mu$  thick,

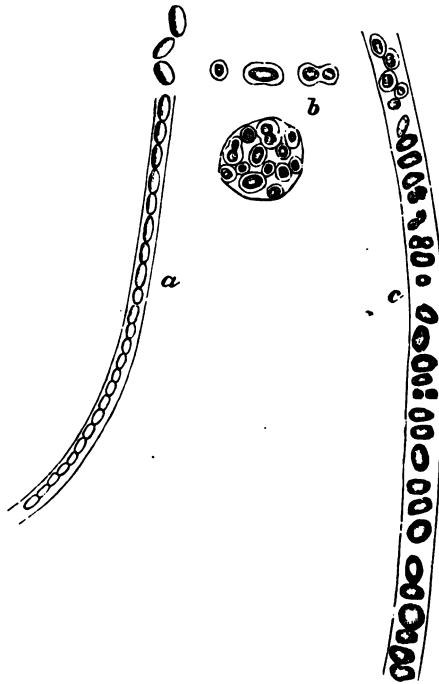


Fig. 57.—*Crenothrix Kühniana* (after Zopf). *a*, vegetative threads; *b*, Palmella form; *c*, spore-forming threads.

increasing to 6–9  $\mu$  towards the end; joints of very varied lengths. Spores 1–6  $\mu$  in diameter. (Fig. 57.)

In wells and drain-pipes, etc.

A Fungus which is often very troublesome, because it defiles the water and stops up the narrower pipes. The cylindrical threads, somewhat clavate above, are visibly articulated; the joints afterwards separate from one another, but are then surrounded by a sheath, which, originally colourless, becomes of a yellow or yellowish-brown colour by impregnation with iron. The sheath, at first closed, is burst at last by the continually dividing joints, which then escape. Each joint can develop a new thread. In other cases, however, the thread remains enclosed in the sheath; its joints are divided by closely contiguous transverse partitions into flat discs, which then break up by vertical partitions into smaller roundish cells; the latter may be designated the spores of the Fungus. They often develop, even while still within the sheath, into new threads, which grow through the gelatinous swollen sheath; or else they leave the sheath, and undergo further development outside it. They either grow into threads, or form by repeated bipartition larger or smaller colonies of roundish cells, held together by their membranes, which assume a gelatinous consistence. These colonies are designated the *Palmella* form (probably the *Palmellina flocculosa* of Radlkofer); each of their cells can again form a thread.

[According to Eyferth, *Bot. Zeitung*, xxxviii. 673, *C. Kühniana* is identical with *Sphaerotilus natans*. A. Giard, *Revue Internat. des Sciences*, x. 190, in describing the infection of the drinking water of Lille, in 1882, by this Fungus, says that the "microgonidia," which are formed by transverse division of the clavate ends of the tubes, exhibit for some time an active movement, and with a high power (Hartnack, No. 12, immersion) he saw the flagellum. A full account of this Fungus will be found in *Quart. Jour. Micr. Sci.*, 1873, p. 163.—TR.]

## CHAPTER II.

## SACCHAROMYCETES.

*The Saccharomycetes, or Yeast Fungi, are unicellular plants, which multiply themselves by budding, and reproduce themselves by endogenous spores. They live singly or united in bud-colonies, chiefly in saccharine solutions, where they excite alcoholic fermentation.*

In most of the Saccharomycetes the cells are round, oval, or elliptic; seldom are they elongated into cylindrical tubes, which are divided by transverse partitions, and may be regarded as the first indication of the formation of hyphæ, *i.e.* of a mycelium. For the purpose of multiplication the cell forms an outgrowth, which is filled with a portion of the contents of the mother-cell, gradually assumes the form and size of the latter, and separates itself from it by a wall. Both cells can in like manner produce fresh daughter-cells, which often remain for a considerable time united with one another, and on separation continue to grow independently.

The formation of spores succeeds most easily on a moist solid substratum. Typically the whole cell-contents divide themselves into 2-4 roundish portions, or contract into a single spherical body. The portions of the contents

58 *Synopsis of the Bacteria and Yeast Fungi.*

surround themselves each with a membrane, and so produce the spores, which can bud like the vegetative cells.

To the Yeast Fungi (in the narrower sense) belongs the capacity of decomposing the sugar of a fluid into alcohol and carbonic acid, *i.e.* of exciting alcoholic fermentation.

The carbonic acid comes off in rapid streams of bubbles, while the alcohol, as well as certain subordinate constituents of sugar, remains behind.

The fermentation proceeds most energetically with restricted access of air; but, if the air is excluded for a long time, the yeast cells perish.

The same is true of the Saccharomycetes, especially in a botanical aspect, as of the Schizomycetes. Just as in the latter case, so also in this, it is necessary to impose a limit upon the accepted species, and only those founded by trustworthy investigators can be considered. Of course there remain even then many doubtful points; for the majority of the now accepted species of Saccharomycetes may be only various forms of one and the same species, which have become differentiated by changed conditions of growth.

XVII. **SACCHAROMYCES**, Meyen (in Wiegmann's *Archiv*, iv. vol. ii. p. 100).

Unicellular Fungi, with vegetative increase by budding, and reproduction by spores, which, for the most part, arise by subdivision of the contents of the mother-cell.

A.—SPECIES NOT PRODUCING A MYCELIUM.

80. **S. cerevisiæ**, Meyen (*l.c.*).

*Torula cerevisiæ*, Turpin.

*Cryptococcus fermentum*, Kützing.

*Cryptococcus cerevisiæ*, Kützing.

*Hormiscium cerevisiæ*, Bail.

[*Saccharomyces minor*, Engel ?]

Cells mostly round or oval, 8–9  $\mu$  long, isolated or united in small colonies. Spore-forming cells isolated,

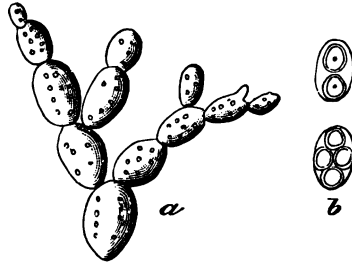


Fig. 58.—*Saccharomyces cerevisiæ*; *a*, a bud-colony; *b*, two spore-forming cells (after Lürssen).

11–14  $\mu$  long; spores mostly three or four together in each mother-cell, 4–5  $\mu$  in diameter. (Fig. 58.)



Fig. 59.—“Low yeast,” *Saccharomyces cerevisiæ*; *a*, the same, budding actively (after Pasteur).

In beer, in both high and low fermentation.

The true beer-ferment is found in the various sorts of



Fig. 60.—“High yeast,” *Saccharomyces cerevisiæ*; *a*, the same, budding actively (after Pasteur).

beer, in both modes of fermentation; it is cultivated on a

large scale, and then yields the German yeast, a mass which consists of yeast-cells and water.

[There are two races of this species, "high" yeast and "low" yeast. The cells of "low" yeast (Fig. 59) are slightly smaller and more oval in shape than those of "high" yeast (Fig. 60), and in budding produce less ramifications, so that there is an absence of the globular clusters which are so striking a feature in the development of "high" yeast, when examined at an early stage of growth. "Low" yeast never rises to the surface of the fermenting fluid, which is thus left clear, but it produces, in the opinion of Englishmen at least, an inferior beer. This is known in England as "Bavarian" beer. With high yeast, the newly formed cells rise to the surface as the fermentation proceeds, and there form large foam-like masses. It is doubtful whether the names "high" and "low" arose from these different positions of the yeast, or from the difference in the temperatures at which they work. High yeast ferments at a temperature between  $16^{\circ}$  C. and  $20^{\circ}$  C., while low yeast is usually employed at a temperature of from  $6^{\circ}$  C. to  $8^{\circ}$  C., and rarely more than  $10^{\circ}$  C. In Pasteur's (from a morphological point of view) confused "*Études sur la Bière*," these are considered as distinct species, but this position is untenable. *S. minor*, Engel, found in fermenting bread, is probably only a form of the same.—TR.]

81. *S. ellipsoideus*, Reess ("Bot. Untersuch. über Alkoholg.," p. 82).

Cells elliptic, mostly  $6\ \mu$  long, isolated or united in little

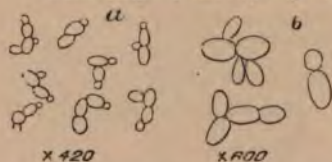


Fig. 61.—a, *Saccharomyces ellipsoideus*; b, the same, more highly magnified.

branched colonies. Spore-forming cells mostly isolated; spores 2-4 together in each mother-cell,  $3-3.5\ \mu$  in diameter. (Fig. 61.)

Producing spontaneous fermentation in must; [this

is the ordinary ferment of wine].

82. *S. conglomeratus*, Reess (*l.c.*, p. 82).

Cells almost round,  $5-6\ \mu$  in diameter, united in clusters,

which consist of the numerous cells produced by budding from one or a few mother-cells. Spore-forming cells often united in twos, or with a vegetative cell; spores 2-4 in each mother-cell. (Fig. 62*b*.)

In wine at the beginning of the fermentation, and on decaying grapes.



Fig. 62.—*a*, *Saccharomyces exiguus*; *b*, *S. conglomeratus*,  $\times 600$ .

83. *S. exiguus*, Reess (*l.c.*, p. 83).

Cells conical or top-shaped, about  $5\ \mu$  long, reaching  $2.5\ \mu$  in thickness, united in sparingly branched colonies. Spore-forming cells isolated, each with 2-3 spores, which lie in a row. (Fig. 62*a*.)

In the after-fermentation of beer.

84. *S. Pastorianus*, Reess (*l.c.*, p. 83).

Cells roundish-oval or elongated-clavate, of varied size.

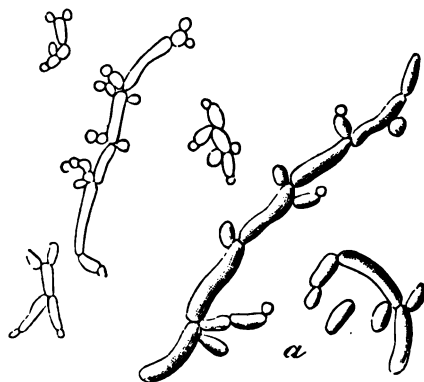


Fig. 63.—*Saccharomyces Pastorianus*; *a*, the same, more highly magnified (after Pasteur).

Colonies branched, consisting of primary clavate cells, 18-

62 *Synopsis of the Bacteria and Yeast Fungi.*

22  $\mu$  long, which produce secondary roundish or oval daughter-cells, 5-6  $\mu$  long. Spore-forming cells roundish or oval; spores from 2 to 4 together, 2  $\mu$  in diameter. (Fig. 63.)

In the after-fermentation of wine, and fruit-wine, or spontaneously fermenting beer. [The "caseous ferment" of Pasteur; may be obtained sometimes in English yeast.]

85. *S. apiculatus*, Reess (*l.c.*, p. 84).

*Carpozyma apiculatum*, Engel.

Cells lemon-shaped, shortly apiculate at each end, 6-8  $\mu$  long, 2-3  $\mu$  broad, sometimes slightly elongated, and,



Fig. 64.—*Saccharomyces apiculatus*,  
× about 500.

according to Hansen, towards the end of their growth becoming oval; daughter-cells arising only from the ends of the mother-cell; for the most part soon isolated, rarely united in small, scarcely

branched colonies. Spores unknown. (Fig. 64.)

In the principal fermentation of wine, and in other spontaneous fermentations. [On all kinds of fruit, stone-fruits, etc., in must, and in certain kinds of beer.]

86. *S. sphæricus*, Saccardo ("Fungi Italici," fig. 76).

Cells of various forms; the basal ones (of a colony) oblong or cylindrical, 10-15  $\mu$  long, 5  $\mu$  thick; the others round, 5-6  $\mu$  in diameter, united in bent, branched, often clustered families. Spore-formation unknown. (Fig. 65.)

On the fermenting juice of *Lycopersicum esculentum*, the tomato.

[Saccardo, who regards this as a Hyphomycete of low organization, says ("Michelia," i. p. 90), "Occurring in minute, flatly convex, gregarious and confluent, dirty-white heaps; conidia perfectly spherical, 5-6  $\mu$  in diameter, collected in variously curved, branched and often

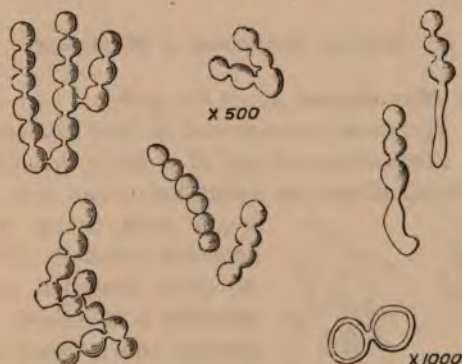


Fig. 65.—*Saccharomyces sphaericus* (after Saccardo).

clustered chains, separating with difficulty, hyaline, usually supported on oblong or subcylindrical bases, 10-15  $\mu \times 5 \mu$ ." There is a strong likeness between this and *Hormiscium album*, Bonorden, except in habitat.]

87. *S. glutinis* (Fresenius), Cohn ("Beiträge," i. p. 187).

*Cryptococcus glutinis*, Fresenius.

Cells round, oval, oblong, elliptic to shortly cylindrical, 5-11  $\mu$  long, about 4  $\mu$  broad, isolated or united in twos, seldom more together. Cell-membrane and contents colourless, when fresh; but, when moistened again after drying, with a faintly reddish central nucleus. Spore-formation unknown. (Fig. 66.)

On starch-paste, slices of potato, etc., forming rose-coloured, slimy spots, which have at first a diameter of  $\frac{1}{2}$ -1 millimetre, but by degrees



Fig. 66.—*Saccharomyces glutinis* (after Cohn).

spread and become confluent in patches of as much as one centimetre broad.

The colouring matter is unchanged by acids and alkalis.

#### B.—SPECIES PRODUCING A MYCELIUM.

##### 88. *S. Mycoderma*, Reess (*l.c.*, p. 83).

*Mycoderma cerevisiæ*, and *M. vini*, Desmazières.

*Hormiscium vini*, and *H. cerevisiæ*, Bonorden.

Cells oval, elliptic or cylindrical, about 6–7  $\mu$  long, 2–3  $\mu$  thick, united in richly branched colonies. The cells are often elongated, so as to resemble a mycelium. Spore-forming cells as much as 20  $\mu$  long; spores 1–4 in each mother-cell. (Figs. 67, 68.)

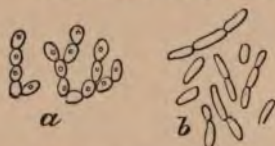


Fig. 67.—*Saccharomyces Mycoderma*, budding; *a* is the *Hormiscium vini* of Bonorden; *b*, a more cylindrical form.

On fermented fluids, sauerkraut, juices of fruit, etc., forming on beer and wine the so-called "mould."

This and the following species reach in their development

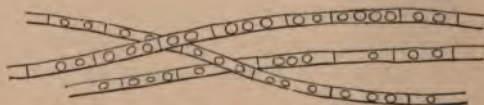


Fig. 68.—*Saccharomyces Mycoderma*, from home-made "ginger-beer," with spores,  $\times 500$ .

the highest rank among the *Saccharomycetes*. The cells often form, especially in watery fluids, long tubes, which are divided by transverse partitions, and fall into single pieces at those points. These bud, in their turn, in the same manner.

While the true Yeast Fungi grow submerged in the higher layers of the fluid, and there excite active alcoholic fermentation, the "mould" grows on the surface, without exciting fermentation. When artificially forced to grow submerged, of course a little alcohol is produced, but the Fungus soon perishes.

Although the growth of the layer of "mould" goes hand-in-hand with the souring of the wine or beer, yet the *Saccharomyces* is not the cause of the latter. The formation of vinegar from alcohol is produced rather by other Fungi, whose systematic position is still undetermined. According to some, it is a species of *Vibrio* (*Spirillum*) which causes this decomposition.

89. *S. albicans* (Robin),  
Reess.

*Oidium albicans*, Robin.

Cells partly round, partly oval, oblong or cylindrical, 3.5-5  $\mu$  thick; the round ones 4  $\mu$  in diameter, the cylindrical ones 10 to 20 times as long as thick. Bud-colonies mostly consisting of rows of cylindrical cells, from the ends of which spring rows of oval or round cells. Spores formed singly in roundish cells. (Fig. 69.)

On the mucous membrane of the mouth, especially of infants, forming the disease known as aphtha, or thrush. Also in animals.

This Fungus appears in the form of larger or smaller greyish-white heaps, which nevertheless do not consist exclusively of the *Saccharo-*



Fig. 69.—*Saccharomyces albicans*. a, beginning of growth; b, further advanced; c, formation of mycelium (after Grawitz).

## 66 *Synopsis of the Bacteria and Yeast Fungi.*

myces, but also contain Schizomycetes and the mycelia of moulds. When cultivated, the Fungus forms long-jointed, richly branched threads; at the upper end of each articulation there is usually a crown or bundle of shorter cells, which are oval or round in form, and bud in their turn. In other cases, all the cells of a bud-colony remain short, and assume a rounded form. This Fungus excites alcoholic fermentation only in a small degree.

According to Grawitz (Virchow's *Archiv für Path. Anat. und Phys.*, vol. lxx. p. 557), *S. albicans* is identical with *S. Mycoderma*.

### C.—DOUBTFUL SPECIES.

#### 90. *S. guttulatus* (Robin).

*Cryptococcus guttulatus*, Robin ("Hist. Nat. Vég. Paras," p. 327).

Cells elliptic or elongated-ovate, 15–24  $\mu$  long, 5–8  $\mu$  thick, brown, opaque, with two to four colourless drops, isolated or from two to five together. Spore-formation unknown.

In the œsophagus and intestines of mammals, birds, and reptiles.

#### [91. *S. coprogenus*, Saccardo et Speggazzini ("Fungi Italici," fig. 911).

Effused, superficial, rather compact, dirty-rose colour; conidia ovoid and then globose, 12–14  $\mu$  long, 10–11  $\mu$



Fig. 70.—*Saccharomyces coprogenus*,  $\times 500$  (after Saccardo).

broad, forming very short chains or solitary, often provided with a tail-like appendage (? from germination), clouded

within, when in clusters pale rose-coloured, hyaline ("Michelia," ii. p. 287). (Fig. 70.)

On fermenting human ordure, where it forms a somewhat waxy layer, almost like a Corticium. This also is considered by Saccardo to be a Hyphomycete.]

[92. *S. olei*, Van Tieghem (*Bull. Soc. Bot. France*, vol. xxviii.).

Cells oval, arranged in branching threads,  $4\ \mu$  long,  $2\frac{1}{2}\ \mu$  broad; cell-contents pale rose-colour.

In olive oil. The oil is changed in appearance by the growth of this Fungus, becoming white and milky from saponification. No gas is disengaged during growth, nor is any special odour perceptible. The ordinary *Saccharomycetes* will not grow in oil.]

[Dr. Klein, *Quart. Jour. Micr. Sci.*, 1883, p. 268, describes a pink "Torula," consisting of cells  $9-10\ \mu$  in diameter, which he assumes to be those of *S. cerevisiae*. It formed pink droplets on a nutrient fluid; the colour was only developed on the free surface, and not in the submerged growth.

What is called the "ginger-beer" plant, used in country districts to produce home-made ginger-beer, consists of "low" or sedimentary yeast, and *S. Mycoderma*, together with various species of *Bacillus*, probably *B. Ulna* and *B. subtilis*, and in addition the "Mucor-ferment" of Pasteur (Fig. 71), which is considered by him to be a submerged vegetating form of *Mucor racemosus*.—Tr.]



Fig. 71. — Mucor-ferment of Pasteur (*Mucor racemosus*), from ginger-beer,

## CHAPTER III.

## CLASSIFICATION.

THE classification of the Schizomycetes is at present in a remarkable transition state. That presented in the foregoing pages, Chapter I., is due in the main to Cohn, and has been supported by Koch, Van Tieghem, and others. It is founded upon the idea, which would obviously occur first to an observer, that all the various morphologically or physiologically distinct forms belong to different species. This idea received strong apparent support from Koch's experiments (*Jour. Roy. Micr. Soc.*, 1881, pp. 950-952, and *Quart. Jour. Micr. Sci.*, 1881, pp. 651-654) in the cultivation of bacterial forms upon gelatine of sufficient consistence to keep the progeny of any one germ in its immediate neighbourhood, and thus prevent that mixture of diverse forms which has been so often perplexing. Under these conditions, according to Koch, *Micrococcus* produced nothing but *Micrococcus*, *Bacterium* nothing but *Bacterium*.

In opposition to this theory, Nägeli, Billroth, Hallier, Hoffmann, Lüders, Cienkowski, Neelsen, Zopf, Haberkorn, and others maintain that in most cases a Schizomycete passes through a series of adaptive forms—that a Micro-

coccus may become a Bacterium, a Bacterium a Bacillus, a Leptothrix, or even a Spirillum and a Spirochæta. Ray Lankester (*Quart. Jour. Micr. Sci.*, xiii., 1873, p. 408) and Lister were the first to promulgate this opinion in England; but the truth of the former's observations, on *Bacterium rubescens*, has been partially denied by several observers, and is not yet entirely free from doubt.

The first classification of the Schizomycetes was that due to Ehrenberg, in 1838 ("Die Infusionsthierchen," p. 75), of which the following is the essential part:—

Cells straight	{ rigid	...	...	...	...	<i>Bacterium</i>
	{ snake-like, flexile	...	...	...	...	<i>Vibrio</i>
Cells spiral	{ flexile	...	...	...	...	<i>Spirochæta</i>
	{ rigid	...	...	...	...	<i>Spirillum</i>

It may be noted that *Vibrio* is here conceived to be naturally straight-lined, but capable of bending in undulations of a serpentine form, being thus distinguished from *Spirillum* by the fact that the undulations lie all in one plane. But most modern observers are agreed that the species referred to *Vibrio* belong to two classes—the one, in which the undulations are serpentine, being merely *Bacillus*; the other, in which they are spiral, being undistinguishable from *Spirillum*. This is, therefore, another reason, added to those which Dr. Winter has given (*supra*, p. 46), why the name *Vibrio* should be dropped.

Cohn's first classification (1872) is merely a modification of Ehrenberg's.

- A. Cells at times united in gelatinous families.
  - a. Cells round, Sphærobacteria ... .. *Micrococcus*
  - b. Cells oblong, Microbacteria ... .. *Bacterium*
- B. Cells never united in gelatinous families.
  - a. Cells thread-like, Desmobacteria.
    - 1. Threads straight ... .. *Bacillus*
    - 2. Threads undulated ... .. *Vibrio*

## b. Cells spiral, Spirobacteria.

- |                         |     |     |     |                   |
|-------------------------|-----|-----|-----|-------------------|
| 1. Spirals flexible ... | ... | ... | ... | <i>Spirochæte</i> |
| 2. Spirals rigid ...    | ... | ... | ... | <i>Spirillum</i>  |

The division into sections A and B is founded upon a mistake, since some of the forms in the latter are now known to occur in a zooglœa. The *Vibrio* here mentioned is distinct from Ehrenberg's *Vibrio*, and included only *V. Rugula* and *V. serpens*.

This classification Cohn revised in 1875 (see *Quart. Jour. Micr. Sci.*, 1876, pp. 259-278), adding the genera *Sarcina*, *Ascococcus*, *Leptothrix*, *Beggiatoa*, *Crenothrix*, *Streptococcus*, *Myconostoc*, *Cladothrix*, and *Streptothrix*, and moreover placing these and the old genera in company with the analogous genera of Algæ in *one* series, as Schizophytæ. But these changes attracted but little notice except among specialists, and the arrangement given above, with a few additions, is that familiar to the majority of the students of Bacteria.

The growth of views inconsistent with this classification will be seen by the following *resumé* of a few of the contrary opinions. The earlier observers, whose opinions were based on insufficient grounds, may be disregarded.

J. Lister (*Quart. Jour. Micr. Sci.*, 1873, pp. 380-408, pl. 19-21) gave an account of several experiments with Bacteria, in which great precaution was taken to ensure accuracy, and in one case, of a Bacterium which appeared spontaneously in milk, he observed coccus, bacterioid, bacillar, and leptothrix forms, and recognised their genetic connection.

Ray Lankester's investigation of *Bacterium rubescens* (1873) has been already noticed. Few even of succeeding writers have gone further in uniting different and apparently distinct forms. See also his further observations in the same journal (1876, pp. 278-283), and *infra*, p. 85.

Geddes and Ewart (*Proc. Roy. Soc.*, xxvii., 1878, p. 481) confirm Lankester's results in the main. J. C. Ewart (*Quart. Jour. Micr. Sci.*, 1878, p. 161), after investigating *Bacillus anthracis*, advocates the doctrine that Micrococcus, Bacterium, and Bacillus are only phases of the same life-history, "which," he says, "is doubtless common to all Bacteria."

Cienkowski ("Zur Morphologie der Bacterien," 1878) held (1) that the zooglœa form is analogous to the Palmella form of chlorophyllose Algæ; (2) that Crenothrix, Leptothrix, and Cladothrix give rise to the zooglœa forms of Bacteria, e.g. of *B. Termo* and *B. Lineola*; (3) that Bacteria are transformed into Micrococci by subdivision, and into Leptothrix by continued growth; (4) that Micrococcus, Bacterium, and the so-called Torula forms are not genetically distinct.

W. Zopf ("Ueber den genetischen Zusammenhang von Spaltpilz-formen," 1881) not only confirmed the views which Cienkowski had previously expressed of the genetic connection of Micrococcus, Bacillus, and Leptothrix, but also asserted that Vibrio, Spirillum, Spirochæta, and Ophidomonas can enter into the same life-cycle with these. He investigated chiefly Cladothrix, Beggiatoa, and Crenothrix. But he allows that not all the Spaltpilze have this pleomorphism, so that it is quite possible that some of them occur under one form only.

C. von Nägeli ("Untersuch. über niedere Pilze" (1882), i. pp. 129-139) maintained that all known forms of Schizomycetes are connected by intermediate links, and that any division into species, however convenient for the purposes of description, has no scientific value. He considers that the same species can occur in widely different forms, according to the circumstances of its nutrition.

J. Haberkorn (*Botan. Centralblatt*, x., 1882, p. 100) puts forward the opinion that all Cohn's four tribes are forms of a single large genus with numerous species, which show alternations of generations and pleomorphy.

W. Zopf ("Zur Morphologie der Spaltpflanzen," 1882) adduced further evidence to prove the truth of the view that all the genera of the Schizomycetes described by Cohn and others, are simply stages of development dependent upon nutrition.

W. Miller (*Archiv für exp. Pathol. und Pharmak.*, xvi., 1882, p. 296) states that he observed transitional forms between *Leptothrix buccalis* and other genera, viz. coccus, bacillus, and spiral forms; and again (*Berichte Deutsch. Bot. Gesell.*, i., 1883, pp. 221-224) he traced the growth of a *Leptothrix* from the teeth of a dog into forms more or less resembling *Bacterium*, *Micrococcus*, *Spirillum*, and *Spirochæta*.

H. Kurth (*Berichte Deutsch. Bot. Gesell.*, i., 1883, pp. 97-99) not only traced the growth of his *Bacterium Zopfii* from *leptothrix* into rod and coccus forms, but also determined the conditions under which one or the other is produced—the rods being the vegetative and the coccus the resting stage.

H. Zukal (*Österr. Bot. Zeitschrift*, xxxiii., 1883, p. 73) connects *Bacillus subtilis*, not only with *Leptothrix parasitica*, but also with the Algæ *L. muralis* and *Drilosiphon Julianus*, Zuk. These observations seem to be founded upon errors.

E. Klein (*Quart. Jour. Micr. Sci.*, 1883, p. 260) describes a torula-like variety of *Bacillus anthracis*, which passed, sometimes even upon the same filament, into the typical *Bacillus*. Similar forms of Bacteria have been described by many others. Klein's growth, however, judging from his figures, does not resemble a true *Saccharo-*

myces. The word "Torula," like "Vibrio," is very much misused by non-botanists. The true Torula belongs to the Hyphomycetes.

F. Neelsen ("Neuere Ansichten über die Systematik der Spaltpilze," *Biolog. Centralblatt*, iii., 1883, p. 545) gives a review of the present state of the question, and confirms Zopf's conclusions.

The most exhaustive account of the new views is contained in Zopf's "Spaltpilze," in Schenk's "Encyclopädie der Naturwissenschaften," 1883. We will first give a condensed account of his previous observations. Taking first *Cladothrix dichotoma*, he found that the pseudo-dichotomous threads resolve themselves by transverse division into short cylindrical cells, which round themselves off by degrees and then represent Micrococci. These Zopf compares to gonidia. From these, after separation, short rods (Bacteria) are evolved, which again, by continuous growth in length and the formation of transverse septa, produce Bacillus-like threads, which ultimately resemble *Leptothrix parasitica*, Kützing. These threads, like the Cladothrix, are surrounded by a delicate gelatinous sheath which takes up iron compounds from the water in which it lives, and thus puts on the appearance of *L. ochracea*, Kützing. From this the typical Cladothrix is produced again by false branching. Moreover, small fragments break off and swim about, and, under certain circumstances, bend into a spiral; these spiral forms are always articulated, and their elements are either rod or coccus like. The height and breadth of the spirals are very variable, as well as the thickness of the threads, and some forms resemble Vibrio, others Spirillum and Spirochæta. The zooglœa form, of even more than one kind, is also met with in Cladothrix.

Zopf also investigated *Beggiatoa alba*, Vaucher, which,

in its *Leptothrix* form, after reaching a certain length, shows a slow oscillating movement. At the ends of the threads Micrococci arise, which unite in a zooglœa and also grow into rods; pieces of the end of the *Beggiatoa* grow crooked, fall off, and form *Spirillum*-like fragments, which swim about by means of flagella.

Again, *Beggiatoa roseo-persicina*, Zopf (*Cohnia roseo-persicina*, Winter), also forms Micrococci; these cocci are of two sizes, which grow genetically one from the other. From the cocci grow threads of very varied lengths. Similar results obtain in *Crenothrix*.

These three genera, *Cladothrix*, *Beggiatoa*, and *Crenothrix*, with *Leptothrix*, form the highest developments of the Schizomycetes; in them a distinction can be made out between base and apex. The mode of vegetative multiplication in this class of Fungi is always by bipartition (from which circumstance, indeed, the name is derived); this bipartition usually takes place in one direction, but occasionally in two or even three. The cells are always enclosed in a cell-wall; this wall is usually composed of cellulose, but in a certain group, viz. the putrefactive Bacteria, it consists of a substance not much different from the cell-contents, to which the name of mycoprotein has been given. This shows a deviation from the vegetable cell in the direction of the animal cell, and accounts for the discrepancies between earlier observers, some of whom, e.g. Dr. Letzerich, always succeeded in obtaining the ordinary cellulose reaction (a blue coloration with iodine and sulphuric acid), while others always failed. All the genera, except the filiform ones, may be provided with flagella. The reproduction by spores has been observed, not only in *Bacillus*, but also in other forms, e.g. by Van Tieghem in *Leuconostoc*, *Spirillum*, *Spirochæta*, and *Bacterium*. There

is mostly only one spore in each cell. The zoogloea forms are produced by aggregation, combined with the same tendency of the cell-walls to gelatinise which is found in many of the lower Algæ.

As the result of his observations, Zopf proposes the following classification:—

- I. COCCACEÆ. Possessing only the (micro-)coccus form, and the thread form which arises from the juxtaposition of the cocci in a line ... .. *Leuconostoc*
- II. BACTERIACEÆ. Possessing four forms, cocci, bacteria (short rods), bacilli (long rods), and leptothrix threads. The last show no distinction between base and apex. No spirals  
*Bacterium, Clostridium*
- III. LEPTOTRICHEÆ. Possessing five forms, cocci, bacteria, bacilli, leptothrix (which last shows a distinction between base and apex), and spiral forms  
*Leptothrix, Beggiatoa, Crenothrix, Phragmidiothrix*
- IV. CLADOTRICHEÆ. Possessing coccus, rod, thread, and spiral forms. Threads provided with false branching (pseudo-dichotomy) ... .. *Cladothrix*

There is one more development of opinion with respect to the Schizomycetes of which mention must now be made. The belief is gaining ground that, among the lowest forms of vegetal life, no such sharp distinction as hitherto can be drawn between those which contain chlorophyll (the algal series) and those which do not (the fungal series). This view, which is embodied in the classification adopted by Sachs in the later editions of his text-book of Botany, is approved by Cohn (see *Quart. Jour. Micr. Sci.*, 1876, pp. 275, 276), and is now supported by Zopf himself. According to the latter, such Algæ as *Glaucothrix* and *Gliothrix*, etc., show *Chroococcus*-like stages of development which answer to the *Micrococcus* stage among the Schizomycetes. The tendency of both to aggregate in gelatinous colonies has been already adverted to. More-

over, Van Tieghem and Engelmann describe (see *infra*, p. 88) bacterioid forms containing chlorophyll, and the resemblance between *Beggiatoa* and *Oscillaria*, both in form and in the characteristic oscillating movement, is so great that some botanists do not yet separate them. Again, *Leuconostoc* differs from *Nostoc* solely in the want of chlorophyll, the very peculiar formation of the spores being alike in both. Compare also *Cohnia* with *Clathrocystis*. The two kinds evidently form two parallel series, which may conveniently be united under the name of *Schizophyta*, being called *Schizophyceæ* and *Schizomycetes* respectively. They are, nevertheless, physiologically so distinct that there are decided objections to interweaving them in one series, as Cohn proposed. It would seem to be proved that, in all cases where oxygen is given off during vegetable growth, chlorophyll is present; Rostafinski at one time believed that *Hæmatococcus* dissociated carbonic anhydride without chlorophyll, but it is now known to be present in that Alga, though masked by the red colouring matter.

There may, perhaps, be detected, in the recent spread of Zopf's views upon the pleomorphy of the Bacteria, a little of that rage for "following the fashion," which is almost as rife among scientific men as in the outer world. A review of what has taken place in similar cases before will teach the necessity of caution. When the swarm-spores of *Algæ* were first discovered, it was prophesied by Siebold that most of the green moving Infusoria, described by Ehrenberg, would be found to be only similar stages of other algal forms. But this prophecy has not been fulfilled. Again, when the doctrine of the pleomorphy of the *Mucorini* was first started by De Bary, it was eagerly seized upon and its scope rapidly extended by rash observers, until in the writings of some authors there was a confusion of species

almost incredible. One writer, Carnoy, even carried the doctrine to the only rational conclusion which could be deduced from such kind of observations as then existed: he asserted that every species of Fungus, cultivated under suitable conditions, could be transformed into *Penicillium*! But later investigators, *e.g.* Van Tieghem, throw grave doubts upon the accuracy of even De Bary's observations, and he himself ("Beiträge," iv. 1) seems to admit that he was mistaken.

There are, however, many cases of pleomorphy in Fungi, which may be considered as proven. We have only to refer to the recent victorious establishment of the pleomorphism of the Uredines, and it is natural to expect that similar cases exist in other groups. But here we may learn another lesson. Not every *Puccinia* passes through the three stages which are typical of a Uredinous fungus; some occur in *one* form alone, so far as our present knowledge goes. The same may be expected to be the case with the Schizomycetes. Even if we grant that some of them do pass through a number of different forms, which have been hitherto described as genera, it need not be inferred that there are no distinct Micrococci, no independent Spirilla. In fact, as evolutionists, considering that we are here dealing with the simplest forms of life, we might anticipate that many of the species would remain permanently, by arrest, in forms which are mere stages of development of those more highly evolved. Moreover, though one stage of *Cladothrix dichotoma* may resemble *Bacterium Termo* in outward form, as Zopf asserts, it by no means necessarily follows that they are identical. There may be differences between them of which we have as yet no cognisance, for little is known of the internal constitution of the Bacteria. What is wanted now is a thorough and searching investigation of all

the so-called species, in various media and under varying circumstances, with the aid of all the modern refinements for keeping the cultivations pure.

There is still another speculation to which the facts appear to lead the way. A species such as those investigated by Zopf is called a "Protean" species, and the various forms are considered to be a series of adaptations to the environment. Nägeli, as we have seen, carried the theory so far as to assert that there are no real species among the Schizomycetes; and Buchner considered that he had transformed the harmless *Bacillus subtilis* by cultivation into the virulent *B. anthracis*, although his conclusions are controverted by Cohn, Klein, and others. Much of the disputation on this topic of "species" arises from the fact that many persons cannot readily conceive a species in the new light which the Darwinian theory has thrown upon it. There can be no doubt that new species not only may, but actually must, be making at the present moment. It is not generally recognised that, to our floriculturists, the making of what would, if spontaneous, be universally considered a new species has been a frequent occurrence. Not only is it probable that *B. anthracis* was developed from *B. subtilis* (whether Buchner's conclusions be true or false), but man, by a change of environment if continued long enough, may at any time produce a similar change in another species. During the siege of Paris, small-pox continued its ravages, gradually assuming a more virulent and malignant form; the cause of this can only be that the micro-organism of small-pox was changing its physiological nature, and, had the conditions been constant for a sufficient length of time, it might ultimately have formed what would be to all intents and purposes a new species. Pasteur's "cultivation" of disease-germs in order to reduce their virulence

is only an application of the same principle in the opposite direction.

It follows (1) that we must consider as a species any form or group of forms which, under present conditions, can be clearly distinguished from all other forms, even though we may know that, if the environment were changed, the species would change too; and (2) that species must necessarily be of various ranks and of various degrees of definiteness, as indeed we know to be the case. And in no part of the scale of organised beings should we expect to find clearer proof and more frequent examples of this doctrine than among the lower Algæ and their derivatives, the lower Fungi.

In conclusion, it may be remarked that neither Cohn nor Zopf have put forward their rival systems as final. At the time of its promulgation Cohn's first arrangement was indeed the only possible one, but he never asserted that all the forms which he catalogued would be found to be true and independent species. Zopf, on the other hand, does no more than devise a system in which certain newly discovered facts may find adequate representation; but he does not pretend that it will include all Schizomycetes. The ultimate classification will probably be a compromise between the two, though the exact form which it will assume it is at present impossible to foresee.

The classification of the Saccharomycetes is in as undecided a state as that of the Schizomycetes, but in a somewhat different way. In this case also there are the two opposing parties—one holding that most of the forms which have been described in Chapter II. are independent species; the other, that they are for the most part only phases of growth of one or a few species; but the third view, which

in the case of the Schizomycetes has attracted but little notice, viz. that they are not autonomous Fungi at all, but merely stages of development of species belonging to other classes, finds here a numerous and active following.

Max Reess ("Zur Naturgeschichte der Bierhefe," 1868, and "Botanische Untersuchungen über die Alkoholgährungspilze," 1870) is one of the most conspicuous upholders of the first doctrine, and his opinions are adopted by Dr. Winter. Hallier and Hoffmann had previously put forward the same doctrine of pleomorphism with regard to the Saccharomycetes which they held for the Schizomycetes; and the latter, in a treatise, "Ueber Bacterien," in the *Botanische Zeitung* (1869, p. 305), maintained, as so many others have done, that the Yeast Fungi are derived from the Moulds; *Penicillium* and *Mucor Mucedo* were the most generally credited with being the source from which they originated. Many other Fungi are now known to have stages of growth in which they simulate the Saccharomycetes. Quite recently, however ("Botanische Untersuchungen," heft v., 1883), Oscar Brefeld has elaborated a comparatively new line of investigation in this respect, and, as no account of his researches has to my knowledge appeared in an English dress, they may be shortly abstracted here. It must be premised that it is impossible to feel much confidence in the results at which he arrives, as he can be convicted of gross carelessness in many parts of his previous work, and the present long and tedious treatise is filled *ad nauseam* with peevish contentious disputations against De Bary and Van Tieghem and all others who differ from his opinions.

Brefeld considers that the conidia of various species of Ustilaginæ exactly resemble in mode of growth many of the forms of the so-called Saccharomyces. It is well known

that the spores of the Smuts, in germinating, protrude a thread from which spring tufts or clusters of sporidia ; these unite with one another by short transverse processes, and then give rise to sporidia or conidia of the third generation, and these to even a fourth kind. Brefeld's theory is that these successive generations of conidia do not merely resemble Saccharomycetes, but are identical with them. He cultivated the spores of many Ustilagineæ in nutrient fluids, and found that the conidia to which they gave rise were in form and dimensions similar to those of the various Yeast Fungi—those of *Ustilago antherarum* being ovate ; of *U. Carbo*, oblong-ovate ; of *U. maydis*, fusiform ; of *U. betonica*, cylindrical ; of *U. Kühniana*, small and roundish ; of *U. cruenta*, filiform ; and so on. Moreover, he cultivated these sporidia in suitable media for numerous generations, and found that they reproduced themselves, so long as the conditions remained unaltered, with unflinching certainty the whole year through. A pair of Smut spores was induced to germinate, and the conidia which they produced were transported, with due precautions, into a drop of nutrient fluid, in which they continued to bud till the nutriment was exhausted. A few of these were then removed to another drop of the same fluid, and the process was continued for nearly thirty times, extending over a space of twelve months. The author considers that he has thus proved that these conidia can propagate themselves indefinitely by budding, just like the cells of Saccharomyces, and he asks, "If we had commenced this series of cultivations, not with the Smut spores, but with the conidia which arise from them, should we have been able to distinguish their mode of growth from that of the yeast of beer?"

As to the other morphological character of the Saccharomycetes, the endogenous formation of the spores, Brefeld

considers truly enough, that this is more closely related to the formation of spores in the sporangia of *Thamnidium*, *Chaetocladium*, and *Choanephora*, than in the asci of the *Ascomycetes*, and that it is exactly paralleled by the formation of zoospores in the conidia of some species of *Peronospora* and *Cystopus*, and that similar phenomena are met with in the *Gymnoasci*.

With respect to the physiological character of exciting alcoholic fermentation, Brefeld says very little, but since the *Mucor*-ferment as well as other *Fungi* is said to possess the same property, it would seem, if all these considerations prove to be true, that the *Saccharomycetes* will have small claim to autonomous rank. To what species, however, if any, they must severally be attached, as budding conidia, remains to be determined. For the present, all this is mere speculation, and the only philosophic course is to treat them as independent *Fungi*, until the contrary is fully demonstrated. The authors who jumble up together *Micrococcus*, *Mucor*, *Ustilago*, *Penicillium*, *Aspergillus*, *Oidium*, *Torula*, and *Saccharomyces* are not the true friends of scientific progress.

## CHAPTER IV.

## PROTEAN AND LITTLE-KNOWN SPECIES.

THE present chapter will include those described Schizomycetes which are inadequately known, or the true bacterial nature of which is undecided, together with those Zopfian species which could not be placed in the Cohnian classification.

**BACTERIUM.**

93. **B. Zopfi**, Kurth (*Ber. Deutsch. Bot. Gesell.*, i., 1883, pp. 97-99, pl. iii.).

Observed in three forms, long leptothrix threads, rods, and cocci. In the fluid nutrient material at 20° C. the rods passed into a swarming stage, and at 35° C. the swarming motion ceased, and short oscillating threads were formed. When the nutrient material was nearly exhausted, the threads broke up into rods, and when it was quite exhausted, each rod divided into two cocci, which for the most part remained united in a figure of eight. When placed in fresh nutrient material, the cocci grew again into rods. Division of the cocci was never observed; they were round or slightly oval, and 1-1.25  $\mu$  in diameter.

In the vermiform appendage of two hens which had died of an epidemic disease. The threads were distinguished by

84 *Synopsis of the Bacteria and Yeast Fungi.*

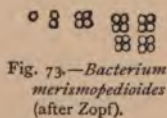
their unusual length, forming long windings, and occasionally close coils. It is interesting to observe that the stages of development appeared to depend upon the quantitative composition of the nutrient fluid, and that the rods were the vegetative and the cocci the resting form. (Fig. 72.)



Fig. 72.—*Bacterium Zopfii*. *a*, a coil of leptothrix threads; *b*, the same coil, nine hours later; *c*, the same, thirty-seven hours later than *b*; *d*, short rods, showing articulations,  $\times 740$  (after Kurth).

94. *B. merismopedioides*, Zopf (*Sitz.-Bericht. Bot. Ver. Provinz Brandenburg*, and "Die Spaltpilze," p. 56).

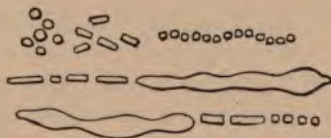
This species forms threads of  $1-1.5 \mu$  in thickness. These subdivide into long rods, then into short ones, and finally into cocci, which have the same diameter as the threads. The cocci pass through a motile stage, and then subdivide, at first in one direction, and then in two, thus forming the characteristic unilamellar plates, which resemble Merismopedia. These colonies may increase till they consist of  $64 \times 64$  cells or more, which finally form a zoogloea. The cocci develop again into threads. (Fig. 73.)



In water containing putrefying substances.

95. *B. aceti* (Kützing), Zopf.

Possesses (1) coccus forms, (2) short rods, (3) long rods, (4) leptothrix threads; all four can form a zoogloea, the two first also form swarms. It is characteristic that the longer rods and threads are not always cylindrical, but often provided with irregular swellings. Such forms have a rather thickened membrane, and a grey colour. (Fig. 74.)

Fig. 74.—*Bacterium aceti* (after Zopf).

Has the power of oxidising alcohol into acetic acid.

96. *B. rubescens*, Lankester (*Quart. Jour. Micr. Sci.*, 1873, p. 408, pl. 22, 23).

Includes a series of forms, motile and immotile, which resemble one another in the possession of a common peach-coloured colouring matter, "bacterio-purpurin," which sometimes becomes reddish-brown. The author observed coccus, bacterioid, bacillar, acicular, and spiral forms, in various modes of combination.

In a fresh-water aquarium in which crayfish (*Astacus*) were decaying.

Cohn considers that *Monas Okenii* (q.v.), which is the form represented by Lankester (*l.c.*, pl. 23, figs. 12, 20), does not belong to this life-cycle, and that the other forms belong to *Cohnia roseo-persicina*; this is now named by Zopf *Beggiatoa roseo-persicina*, because it possesses a *Beggiatoa* phase, which is mentioned by Lankester himself in his second article (*l.c.*, 1876, p. 283). Archer also unwittingly records the *Beggiatoa* phase in the same journal. Geddes and Ewart describe ("On the Life-History of *Spirillum*," *Proc. Roy. Soc.*, xxvii., 1878, p. 481) a madder-brown growth, which is evidently identical with Lankester's, and in which they have observed and figured the *Beggiatoa* phase, without perceiving its true significance, and mistaking also the sulphur granules for "spores." Mixed with this was a *Spirillum*,

## 86 *Synopsis of the Bacteria and Yeast Fungi.*

probably belonging to the same life-cycle, in which true spores were produced; the germination of these, which they observed, took place by the emission of a short curved tube, giving the spore a "comma"-like appearance; the tube soon became spiral. (See *Spirillum rosaceum*, Klein, p. 94.)

### 97. *B. sulfuratum*, Warming (*l.c.*, p. 6 of the Resumé).

Warming gives this name to a series of forms which he discovered on the coasts of Denmark, all of which he considers to be connected by intermediate stages. He includes under it *Monas vinosa*, Ehrenberg, *M. erubescens*, Ehrenberg, *M. Warmingii*, Cohn, and *Rhabdomonas rosea*, Cohn, as well as spiral forms. His *M. gracilis*, moreover, seems to differ merely in being more slender than *Rhabdomonas*, and was met with only in fresh water. All these are of a pale pink colour, and contain numerous sulphur granules. It appears to be distinct from *B. rubescens*, Lankester, in all its varieties.

### 98. *B. lactis*, Lister (*Quart. Jour. Micr. Sci.*, 1873, pp. 380-408).

Includes coccus, bacterioid, bacillar, leptothrix, and saccharomycetoid forms, motile and immotile, which the



Fig. 75.—*Bacterium lactis*,  $\times 1140$  (after Lister).

author obtained by pure cultivation of the Bacterium that appeared spontaneously in milk kept in a dairy. The long rods appear to be formed by segmentation of the leptothrix threads, these subdivide into short rods, and these into

cocci; the cocci can grow again into threads. The cocci are about  $.5 \mu$  in diameter, mostly in pairs or fours, or in chains; the rods and threads  $1.25 \mu$  in diameter. (Fig. 75.)

Producing the lactic acid fermentation in boiled milk. Resembles *Bacillus subtilis*, (?) identical. This is interesting, as being one of the earliest observations of pleomorphism in the Schizomycetes.

99. **B. foetidum**, Thin (*Proc. Roy. Soc.*, xxx., 1880, p. 473, pl. 6).

Occurred as Micrococci, singly or in pairs,  $1.25-1.4 \mu$  in diameter. On cultivating them, with proper precautions, he found also short and long rods, and leptothrix threads, and all the stages of transition between these and the Micrococci. In the rods, oval spores about  $1.5 \mu$  long were formed, one at each extremity of a cell, as in *Bacillus*. (Fig. 76.)



Fig. 76.—*Bacterium foetidum*,  
 $\times 900$  after Thin).

In the alkaline serous exudation from the soles of the feet of a person who suffered from profuse sweating of the feet, producing a foetid odour, also observable in the cultivations, in which, however, it became gradually weaker.

100. **B. decalvans**, Thin (*Proc. Roy. Soc.*, xxxiii. p. 247, pl. 3).

Occurred as minute bodies, highly refractive, of a definite size and fixed shape, about  $1.6 \mu$  long, usually in pairs. They became more numerous as the hairs became worse affected by the disease. (Fig. 77.)



Fig. 77.—*Bacterium decalvans*,  
 $\times 600$  (after Thin).

In and on the roots of the hairs in *Alopecia areata*. Dr. Thin supposes that they penetrate downwards between the root-sheath and the hair,

88 *Synopsis of the Bacteria and Yeast Fungi.*

then penetrate the cuticle of the hair, and finally ascend within its substance, causing it soon to fall off.

101. **B. lucens**, Van Tieghem (*Bull. Soc. Bot. France*, 1879, p. 141).

Motionless, remarkable for its strong refringence and brilliancy. Each cell forms a spherical spore.

On the surface of water containing other organisms.

102. **B. photometricum**, Engelmann (*Revue Internat. Sci.*, ix, 1882, p. 469).

Cells of a slightly reddish colour; the author describes neither their form nor size. The micro-spectroscope shows a strong absorption of all the rays whose wave-length is less than  $\cdot 62 \mu$ , especially of those between  $\cdot 62$  and  $\cdot 59$  (orange). It is sensitive in a high degree to the influence of light. (For details, see *Jour. Roy. Micr. Soc.*, 1882, p. 656, and 1883, p. 256.)

103. **B. chlorinum**, Engelmann (*l.c.*, p. 276).

Cells  $2-3 \mu$  long, motile, of a greenish colour, paler than that of a chlorophyll granule of the same size. It presents in a high degree the tendency to accumulate in the light, but only when oxygen is absent; according to the author, it disengages oxygen in the light, and is therefore not a Schizomycete at all.

104. **B. viride**, Van Tieghem (*Bull. Soc. Bot. France*, 1880, p. 174).

Rods minute, of a pure green colour, constricted in the middle, dividing frequently, and separating after each segmentation, but otherwise immotile. In a large number of

rods it forms spores, colourless, very refringent, of a spherical or slightly oval form, like those of a Bacillus.

In the rain-water which filled the cavity of the pileus of a young Polyporus, forming a thin layer.

This can scarcely be a Bacterium. The colouring matter, according to Van Tieghem, is true chlorophyll. He compares it to *B. lucens*.

Wakker records (*Bot. Centralblatt*, 1883, p. 315) a Bacterium resembling *B. Termo*, causing the "yellow disease" of hyacinths. It occurred in a yellow slime in the bulbs in autumn, and in the leaves in spring. He calls it *B. hyacinthi*.

### BACILLUS.

105. *B. crassus*, Van Tieghem (*Bull. Soc. Bot. France*, 1879, p. 142).

Cells motionless, large, resembling *B. Ulna*, 4  $\mu$  broad during active growth, 5-6  $\mu$  when forming spores. Spores spherical, 5  $\mu$  in diameter.

The spores of this species are the largest known among the Schizomycetes. It does not produce starch.

106. *B. malariae*, Tommasi-Crudeli (*Atti R. Accad. Lincei, Trans.*, vi., 1881, p. 19).

In the spleen, the medulla of bones, the lymphatic glands, and the venous blood of persons suffering from malarial fever. The evidence of the existence of this species is at present unsatisfactory.

107. *B. puerperalis*, Engel (*Comptes Rendus*, lxxxviii., 1879, p. 976).

In the blood of a woman who had died in childbirth. Engel observed the production of conidia.

108. *B. mollusci*, Domenico (*Atti R. Accad. Lincei, Trans.*, v., 1880).

Resembling *B. leprae*. In the nodules of *Molluscum contagiosum*.

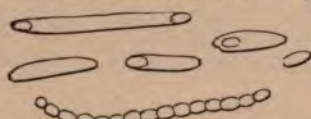
109. **B. virens**, Van Tieghem (*Bull. Soc. Bot. France*, 1880, p. 175).

? *Leptothrix tenuissima*, Rabenhorst.

? *L. subtilissima*, Rabenhorst.

? *Sporonema gracile*, Perty. (Fig. 78.)

Filaments slender, of a greenish-yellow colour, usually



immotile, but sometimes moving; cells long, resembling those of *B. anthracis*, forming a very

refracting, oval, colourless spore, slightly thicker than the threads. Spores in germinating put forth a slender filament, soon septate, at first colourless, but becoming green like the original threads in the light.

In stagnant water among *Spirogyra*.

Perty observed the spores of this species, if it is identical with his *Sporonema*. It seems a doubtful *Schizomycete*.

110. **B. beribericus**, De Lacerda.

This has been discovered in the blood of patients suffering from the disease known in the tropics as beri-beri. It consists of cylindrical, articulated, branched (?) filaments, containing sometimes brilliant refracting points, which are believed to be spores. The filaments cultivated after Pasteur's method, with due precautions, and injected into rabbits, caused all the symptoms of beri-beri. M. de Lacerda believes that the parasite is originally derived from rice which has undergone a peculiar alteration (*Lancet*, February 9, 1884, p. 268).

#### *Bacillus of Cholera.*

The Commission sent out by the German Government, under Dr. Koch, has observed in the bodies of cholera

patients in India, in every case, the same Bacilli that they found in Egypt. But it was still undecided whether these Bacilli did not belong to the regular parasites of the gut, having made their way into the mucous membrane of the intestine under the influence of the cholera disease. Some of the Bacilli were, therefore, isolated from the intestinal contents of the purest cholera cases and cultivated in gelatine, so as to investigate their distinctions from other Bacilli. In this way it was demonstrated that this kind of Bacillus was present in all the choleraic evacuations examined, as well as in all the intestinal contents from persons who had died of cholera. On the other hand, the bodies of eight persons who had died of pneumonia, dysentery, phthisis, and kidney-disease were examined, as well as the bodies of several animals, and other substances abounding in bacteria, but in none of these cases was the cholera Bacillus found. It is also reported that the same organism was discovered in water from a tank, which had been suspected of being a source of the disease.

*Bacillus of Syphilis.*

Despite the strenuous efforts which have been made to demonstrate the existence of a specific Bacillus of syphilis, it must be admitted that the evidence is as yet inconclusive.

There are also described the Bacillus of the pneumo-enteritis of the pig (Klein, *Proc. Roy. Soc.*, xxvii. p. 101), which resembles *B. anthracis*, but differs in the cylindrical spores, which measure only  $5\mu$  in length; the Bacillus of malignant oedema (Koch); *B. ureæ* (Miquel); and a Bacillus in a badger's liver (Eberth).

**DISPORA.** \*

111. **D. Caucasica**, Kern (*Bot. Zeitung*, xl., 1882, p. 264).

Cells resembling *B. subtilis*, 3·2–8  $\mu$  long, ·8  $\mu$  broad, with a flagellum at each end. Forming long leptothrix threads by growth and cell-division, and then producing spores, which "stand on their ends," *two* in each cell. Spores round, ·8  $\mu$  in diameter, afterwards increasing to 1  $\mu$ .

In "kephir," a drink prepared by the inhabitants of the high-lying lands of the Caucasus, by fermentation of cows' milk. (See *Nature*, 1882, p. 43, and *Jour. Roy. Micr. Soc.*, 1882, p. 383.)

This may be the result of mal-observation. In *B. subtilis*, when a cell is elongated, and about to divide, two spores are sometimes found in one cell.

**BEGGIATO.**

112. **B. nodosa**, Van Tieghem (*Bull. Soc. Bot. France*, 1880, p. 176).

Filaments colourless, very slender, motionless; articulations shorter than broad; no sulphur granules. At intervals some of the cells become more refringent, enlarge, and persist like spores, and form nodosities on the filament. Similar monstrosities exist, according to Van Tieghem, in true *Oscillarias*. This is not a true *Beggiatoa*.

**PHRAGMIDIOTHRIX**, Engler.

Differs from *Beggiatoa* in the want of sulphur granules and the continuous subdivision of the cells, and from *Crenothrix* in the want of a sheath.

113. *P. multiseptata*, Engler ("Pilz-veg. weiss. oder todt. Grundes in der Kieler Bucht").

*Beggiatoa multiseptata*, Engler (*Sitz.-Bericht. Bot. Ver. Provinz Brandenburg*, 1882, p. 17).

Threads 3-6  $\mu$  broad, separated by transverse partitions into short cylinders, whose height is only one-fourth to one-sixth of their breadth. These discs are separated by repeated transverse and longitudinal division into cocci, which probably become isolated. From these cocci very slender threads arise which afterwards become thicker.

Attached to the legs of crabs (*Gammarus*) in sea-water.

### LEPTOTHRIX.

114. *L. gigantea*, Miller (*Ber. Deutsch. Bot. Gesell.*, 1883, pp. 221-224, pl. vi.).

Occurred as bundles or tufts of diverging threads, which varied very considerably in thickness in the same tuft, from 5-4  $\mu$ ; threads 250  $\mu$  long or more, showing a distinction between base and apex, the thicker ones consisting of articulations, which formed cocci, short rods, or long rods, sometimes all in the same thread. Some of the threads showed a sheath, from which the articulations passed out, collecting in a heap at the extremity. Articulations round, oblong, or pear-shaped; the larger ones dividing into smaller, first by a transverse and then by a longitudinal septum. Some of the threads assumed a spiral form, and even approached Spirochæte. (Fig. 79.)



Fig. 79.—*Leptothrix gigantea*. *a*, base of a tuft of threads,  $\times 540$ ; *b*, stages of subdivision of the threads (after Miller).

In the teeth of a dog suffering from *Pyorrhæa alveolaris*, and subsequently in the bite of other carnivorous and herbivorous mammals, sheep, cattle, pigs, horses, cats, etc. The subdivision of the larger cocci and the septation of the finer threads were only made visible by staining.

This is considered by Miller as affording a very strong proof of the truth of Zopf's theory. It resembles *Beggiatoa alba* and *Crenothrix Kühniana*. Miller also found the same stages in *L. buccalis* (see Fig. 27a) in carious teeth; in this the cocci penetrated into the tooth more deeply than the rods, and they in turn than the longer threads (*supra*, p. 72). It is to be remarked, however, that what are here called cocci, rods, and spiral forms are not the exact counterparts of typical Micrococci, Bacteria, and Spirilla. (See also F. Y. Clark, in Johnston's *Dental Miscellany*, 1879, p. 447, who describes a Bacterium in the teeth, 1.5-3  $\mu$  long, .5  $\mu$  broad, of a somewhat spiral form.)

### SPIRILLUM.

115. *S. rosaceum*, Klein (*Quart. Jour. Micr. Sci.*, xv., 1875, p. 381).

Resembling *S. Undula*, but reddish in colour; colouring matter insoluble in water, alcohol, or chloroform.

Seems to be identical with *S. rufum*, Perty (Pritchard, "Infusoria," p. 534), and possibly not different from the form recorded by Geddes and Ewart (*Proc. Roy. Soc.*, 1878, p. 482). It is distinct from *S. sanguineum*, Cohn, with which it has been confounded (see also *Bacterium rubescens*, p. 85).

116. *Spirulina alba*, Van Tieghem (*Bull. Soc. Bot. France*, 1880, p. 177).

Absolutely colourless. Filaments very long and slender, resembling *S. tenuissima*. Coils so close together as almost to touch and form a hollow tube. Turning actively round its axis, and also oscillating laterally as a whole.

Forming a thin white layer on the muddy bottom of

an abandoned mill-race. This, if the want of colour were not accidental, would appear to be a Schizomycete.

### CRYPTOCOCCUS.

#### 117. *C. xanthogenicus*, Freire.

Resembling a Micrococcus. Said to have been discovered in Brazil, in persons suffering from yellow fever.

Dr. Freire, having cultivated this in gelatine for six generations, says that, when introduced into the body by "vaccination," it produced a mild type of yellow fever; he had previously observed that rabbits and guinea-pigs, so inoculated, were proof against the fatal type of the disease.

*Micrococcus* sp. W. Archer describes (*Quart. Jour. Micr. Sci.*, xiv., 1874, p. 321) a "black" Micrococcus, really blue-black, consisting of cells rounder than in *M. prodigiosus*, arranged in twos or fours, the latter in a square, not in a straight line.

### SARCINA.

#### 118. *S. solani*, Reinke et Berthold ("Die Zersetzung der Kartoffel durch Pilze," p. 22, pl. vii. fig. 13).

Cells small, colourless, round or before division oval; some free, others collected in unilamellar colonies of from 4 to 24;  $1\cdot3-2\ \mu$  in diameter. (Fig. 80.)

In rotting potatoes. (See *Bacterium merismopedioides*, Zopf, *supra*, p. 84, with which this seems to be identical.)



I have found a very similar Schizomycete in putrefying starch-paste, which differed in scarcely any respect except its much larger size, the colourless cells being perfectly round and  $6-8\ \mu$  in diameter. It occurred singly or in pairs or fours, always unilamellar, the tetrads being collected together in families of 16, 24, or more cells.

Fig. 80.—*Sarcina solani*.  
a, side view of two plates,  $\times 940$  (after Reinke and Berthold).

**POLYBACTERIA**, Van Tieghem (*Bull. Soc. Bot. France*, 1880, p. 149).

Under this and the following genera, Van Tieghem places some bacteria which are probably only zooglæa stages of other species, like *Ascococcus*, which they resemble.

119. **P. catenata**, Van Tieghem (*l.c.*, p. 150).

Colonies naked, oval, colourless, composed of short rods aggregated without order; the colonies divide transversely in such a manner as to remain attached end to end in a flexuous chain.

In a decoction of horse-dung.

120. **P. sulfurea**, Van Tieghem (*l.c.*, p. 150).

Colonies rounded or polyhedral, composed of short rods of a sulphur colour; the colonies divide in two directions at right angles to one another, so as to form a simple layer.

On the surface of a liquid in which haricot-beans were decaying.

**PUNCTULA**, Van Tieghem (*l.c.*, p. 150).

Differing from *Polybacteria*, in the cells of which it is composed being round.

121. **P. rosea**, Van Tieghem (*l.c.*, p. 150).

Colonies single, of a bright rose colour, spherical; cells round, extremely small, arranged in radiating lines and concentric circles.

122. **P. cubica**, Van Tieghem (*l.c.*, p. 150).

Colonies cubical, dividing successively parallel to each

face, so as to form cubical masses. Cells rather larger than in *P. rosea*, colourless, round.

123. **P. glomerata**, Van Tieghem (*l.c.*, p. 150).

Colonies rounded, colourless, dividing in three directions, and remaining associated in lobed masses.

All three forms were met with on putrefying seeds.

**ASCOBACTERIA**, Van Tieghem (*l.c.*, p. 151).

This consists of colonies surrounded by a thick gelatinous membrane, and bears the same relation to Polybacteria that Cohn's *Ascococcus* does to *Punctula*.

124. **A. ulvina**, Van Tieghem (*l.c.*, p. 151).

Colonies polyhedral, enveloped in a thick cartilaginous membrane, forming a coherent membrane like an *Ulva*, composed of short rods aggregated without order, which increase by bipartition.

On the surface of liquids in which leguminous seeds, especially of lupin, were decaying.

**ASCOCOCCUS**, Cohn.

125. **A. vibrans**, Van Tieghem (*l.c.*, p. 151).

Similar to *A. Billrothii*, but the cells oscillated and whirled round, as in the Brownian movement.

On the surface of water in which *Beggiatoa* was growing.

All these aggregated bacteria of Van Tieghem live on the surface of fluids, and often, if not always, disengage ammonia, like *Ascococcus*.

# MONAS.

The following species, placed under Monas, are considered by Warming to belong to the Schizomycetes:—

126. **M. vinosa**, Ehrenberg ("Die Infusionsthierchen," p. 11).

*Chromatium violascens*, Perty.

Cells ovate, rounded at each end, very small, 2-4  $\mu$ , of a wine-red colour. Motion very slow and tremulous.



Fig. 81.—*Monas vinosa* (?)  $\times 660$  (after Warming).

The form which Warming considers identical with this is spherical or more commonly oval, 5-4  $\mu$  in length, pinkish-red, granular, actively motile, with a flagellum. (Fig. 81.)

In water containing decaying vegetable matter.

127. **M. Okenii**, Ehrenberg (*l.c.*, p. 15).

*Chromatium Weissii*, Perty.

Cells cylindrical, equal, slightly curved, abruptly rounded at each end; 7-15  $\mu$  long, but, according to Warming, much longer, 5  $\mu$  broad, of a bright red colour, motile; the granules are pretty evenly distributed throughout the body; furnished with a flagellum, in the large specimens one at each end. Movements slow. (Fig. 82.)



Fig. 82.—*Monas Okenii*,  $\times 660$  (after Warming).

In stagnant water. According to L. Olivier (*Bull. Soc. Bot. France*, 1882, p. 216), *M. Okenii*, which Lankester

admitted to be one of the forms described by him under *Bacterium rubescens*, is not a Schizomycete, but a true monad,

destitute of ternary envelope, and he places it among the Nudo-flagellata.

128. *M. Warmingii*, Cohn.

Cells cylindrical, rounded at the ends, pinkish, with the granules accumulated at the extremities;  $15\ \mu$  long,  $5\text{--}6\ \mu$  broad (according to Warming),  $8\ \mu$  (Cohn), with a flagellum. Movements rapid, but irregular. (Fig. 83.)

In brackish water.



Fig. 83. — *Monas Warmingii*,  $\times 660$  (after Warming).

129. *M. erubescens*, Ehrenberg (*l.c.*, p. 11).

Warming considers this identical with *M. Warmingii*, differing only in having the granules equally distributed;  $14\ \mu$  long,  $6\text{--}7\ \mu$  broad.

In brackish water.

130. *M. gracilis*, Warming (*l.c.*, p. 6 of the Resumé).

Cells straight, cylindrical, slender, rounded at the ends, pinkish;  $60\ \mu$  long or less,  $2\ \mu$  broad; paler than *M. Okenii*, with few sulphur granules. Movements slow; sometimes slightly curved. (Fig. 84.)

In fresh water.

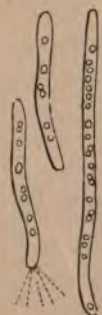


Fig. 84.—*Monas gracilis*,  $\times 660$  (after Warming).

131. *M. Mülleri*, Warming (*l.c.*, p. 18 of the Resumé).

*Volvox punctum*, Müller.

Cells spherical or oval,  $5\text{--}15\ \mu$  long, having usually one extremity filled with angular and very refringent granules, the other empty and hyaline. Granules whitish,

with a blue tinge and a dark border. Movements incessant. A flagellum (?). (Fig. 85.)

In sea-water.

132. *M. fallax*, Warming (*l.c.*, p. 18 of the Resumé).

Cells small, 4-5  $\mu$  long, 3  $\mu$  broad, oval, sometimes



Fig. 85.—*Monas Mülleri*,  
 $\times 660$  (after Warming).



Fig. 86.—*Monas fallax*,  
 $\times 660$  (after Warming).

curved or angular, and almost entirely filled with crystalline and very refringent granules. Movements rapid. (Fig. 86.)

Warming considered that some of these monads may be the zoospores of *Beggiatoa*.

133. *Rhabdomonas rosea*, Cohn.

Cells fusiform, pinkish, granular; 20-30  $\mu$  long, 4-5  $\mu$  broad. Movement slow; with a flagellum. (Fig. 87.)

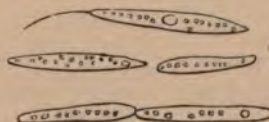


Fig. 87.—*Rhabdomonas rosea*,  $\times 600$   
(after Cohn).

Some of Warming's specimens were cylindrical, 3-4  $\mu$  broad, 15-35  $\mu$  long, or more; but he figures spindle-shaped forms as well.

In brackish and fresh water.

## APPENDIX A.

## ON THE UNIT OF MICROSCOPICAL MEASUREMENT.

IT has for some time been the general practice on the Continent, and is beginning to be so in England, to give the dimensions of microscopic objects in terms of a thousandth of a millimetre, which is called a micro-millimetre, and is variously designated by the abbreviations  $\mu$ , *mk.*, and *mmm.* The first abbreviation, being the shortest, is the most generally adopted ; but there seems still to be a prejudice existing against this unit, from a want of knowledge of the advantages which its use confers or of the mode of using it. In the first place, it is always easier to conceive the size of any object, and especially to realise the comparative sizes of two objects, when their dimensions are given in terms of a unit smaller than either ; for instance, it is difficult exactly to comprehend the length represented by  $\frac{1}{288}$  of an inch, and few people can readily compare such dimensions as  $\frac{1}{18}$  and  $\frac{1}{27}$  of an inch.

All this difficulty vanishes when the dimensions are expressed as multiples of a small, properly chosen unit, and not as fractions of a large one. For this purpose a fraction of an inch might be adopted instead of a fraction of a millimetre ; but, at any rate in measuring the spores of Fungi,  $\frac{1}{10000}$  of an inch is too large a unit, and  $\frac{1}{100000}$  of an inch would be inconveniently small. It happens that, if we take  $\frac{1}{1000}$  of a millimetre as our unit, we can express the size of the spores of all Fungi, and also of many other microscopic organisms, in the fewest possible figures. For instance, many of the Micro-

cocci measure about  $1\ \mu$ , the spores of *Penicillium* about  $3\ \mu$ , the spores of many *Myxomycetes* about  $10\ \mu$ , and so on. If we compare these figures with the following :  $\cdot 001\ \text{mm.}$ ,  $\cdot 003\ \text{mm.}$ ,  $\cdot 01\ \text{mm.}$ , or still more with these :  $\cdot 00004\ \text{in.}$ ,  $\cdot 00012\ \text{in.}$ ,  $\cdot 0004\ \text{in.}$ ,—we see the great saving effected in the trouble of writing down the dimensions, quite apart from the greater readiness with which they can be compared with one another.

But perhaps the difficulty with some is that of realising and actually applying this unit ; I will therefore give an easy method by which the size of the micro-millimetre may be obtained. Place your microscope in such a position that the image projected upon a piece of white paper is magnified 254 times : this can easily be done by a quarter-inch objective with the use of the draw-tube, or by placing the paper at a greater distance than ten inches from the eye-piece. Let this position be marked, so that the microscope can be placed in it again at any time. Now copy on the paper, from a scale, an inch divided into ten parts, and with a fine pen subdivide each tenth into five equal parts. Then the value of each of these subdivisions will be  $2\ \mu$ , and of the whole tenth of an inch,  $10\ \mu$ . If this scale be carefully copied on a piece of thin cardboard or other suitable substance, the dimensions of any minute object, drawn by the camera or otherwise on the paper in that position of the instrument, can be easily read off in  $\mu$ 's. With the aid of a deeper eye-piece or higher objective we can magnify the image 508 times, and then each small division of the scale will represent  $1\ \mu$ .

## APPENDIX B.

## ON THE STAINING OF "BACILLUS TUBERCULOSIS."

PROFESSOR KOCH (*Verh. Physiol. Gesell.*, Berlin, 1882, p. 65) first announced the discovery of the *Bacillus* of tuberculosis. He placed the fluid from the diseased tissues in a mixture of 1 c. cm. of a concentrated solution of methylene blue in alcohol, 0.2 c. cm. of a 10-per-cent. solution of potash, and 200 c. cm. of distilled water. By this the preparation is coloured blue, and a few drops of a solution of vesuvin are then placed on it. This discharges the blue from every part except the Bacilli, which remain blue in a brown field, but are not easily seen.

Ehrlich's method, especially as modified by Heneage Gibbes, is more successful. The colours used by the latter are magenta crystals and chrysoidin, which is a brown that does not stain the ground so intensely as vesuvin. (1) Take 2 grm. of magenta crystals, 3 grm. of pure aniline, 20 c. cm. of alcohol (specific gravity, 830), 20 c. cm. of distilled water. Dissolve the aniline in the spirit, and rub up the crystals with it in a glass mortar, adding the spirit gradually till they are all dissolved; then add the water slowly, while stirring, and keep in a stoppered bottle. (2) Make a saturated solution of chrysoidin in distilled water, and add a crystal of thymol to make it keep. (3) Make a dilute solution of commercial nitric acid, one part of acid to two of distilled water. Spread a thin layer of sputum on a cover-glass, and let it dry; when quite dry pass it two or three times through the flame of a small Bunsen burner, and let it cool. Filter two or three drops of the magenta

solution in a watch-glass; place the cover-glass, with the sputum downwards, on the stain, taking care that there are no air-bubbles under it. Let it remain for fifteen or twenty minutes; then wash in the dilute acid till all colour has disappeared. Remove the acid with distilled water; then place the cover-glass in the same manner as before on a few drops of chrysoidin, filtered into the bottom of a watch-glass, and let it remain for a few minutes till it has taken a brown stain. Wash off the superfluous colour in distilled water, and place the cover-glass in absolute alcohol for a few minutes. Then remove and dry perfectly in the air, and mount in a solution of Canada balsam. The Bacilli are visible with a quarter-inch objective. (See *Lancet*, ii., 1882, p. 183.) By this process only *B. tuberculosis* is stained, the ordinary putrefactive bacteria remaining colourless.

Prideaux (*l.c.*, p. 1138) uses methylene-blue instead of chrysoidin for staining the ground; by this means the Bacilli show up red on a blue background. The process may fail if the solutions are at a lower temperature than 100° F., and Professor Brun recommends that the sputum should not be exposed to a greater heat than 176° F. If gentian violet be used, after the nitric acid treatment, the putrefactive bacteria will be stained, and not the tubercle bacilli, which are thus strongly differentiated. The latter are also stained by fuchsin.

The following is Heneage Gibbes's rapid method of demonstrating *B. tuberculosis* without nitric acid. Take of rosaniline hydrochloride 2 grm., methyl-blue 1 grm.; rub in a glass mortar. Then dissolve aniline oil 3 c. cm. in rectified spirit 15 c. cm.; add the spirit slowly to the stain till all is dissolved; then slowly add distilled water 15 c. cm.; and keep in a stoppered bottle. Place a few drops of the stain in a test-tube, and warm; as soon as steam rises, pour into a watch-glass, and place the cover-glass as before. After four or five minutes wash in methylated spirit till no more colour comes away; drain thoroughly, and dry either in the air or over a spirit-lamp. Mount in Canada balsam. A section of tissue containing Bacilli can be treated in the same way, only it must be left in the stain for several hours.

## APPENDIX C.

### DISEASES PRODUCED BY THE SCHIZOMYCETES.

THE following classification of the Schizomycetes and the diseases produced by them, arranged according to Cohn's system, was read before the British Medical Association, by Dr. Julius Dreschfeld, in 1883 :—

- I. SPHÆROBACTERIA (Micrococci) : spherical or oval cells, rather less than  $1\ \mu$  in diameter, occurring singly or in pairs (diplococci) or in masses (zoogloea).
  - a. Chromogenous—*M. prodigiosus*.
  - b. Zymogenous—*M. ureæ*.
  - c. Pathogenous—In the following diseases :—
    - Acute abscess.
    - Pyæmia.
    - Septicæmia.
    - \*\* Septicæmia in mice (Koch).
    - \*\* Erysipelas.
    - Osteomyelitis.
    - Endocarditis ulcerosa.
    - \* Diphtheria.
    - \*\* Gonorrhœa.
    - \* Pneumonia.
    - Cerebro-spinal meningitis (Aufrecht).
    - Cerebral meningitis (Leyden).
    - Acute yellow atrophy of liver.
    - Variola.
    - Scarlatina.
    - Measles.
    - Typhus (Mott).

---

\*\* Those diseases in which it is fully established that the micro-organism is the causal agent ; \* those in which it is less fully proved ; the rest are doubtful.

Syphilis (Birsch-Hirschfeld, Klebs).

Dysentery (Prior).

Whooping-cough (Burger).

II. MICROBACTERIA : small cylindrical or elliptic rods, occurring singly or in pairs or in zoogloea masses.

a. Chromogenous—*Bacterium synxanthum* (in yellow milk).

*B. æruginosum* (in blue pus).

b. Zymogenous—*B. Termo* (in putrefaction).

*B. Lineola* (in stagnant water).

*Mycoderma aceti* (in acetic acid fermentation).

c. Pathogenous—In \*\* Septicæmia of rabbits (Koch).

\*\* Chicken cholera (Pasteur).

Typhus? (Klebs).

III. DESMOBACTERIA.

1. BACILLI : longer rods, often showing the formation of spores.

a. Chromogenous—*Bacillus ruber* (in boiled rice).

b. Zymogenous—*B. subtilis* (in hay infusion).

*B. butyricus* (in butyric acid fermentation).

c. Pathogenous—In the following diseases :—

\*\* Anthrax.

\*\* Glanders.

\*\* Septicæmia in mice (Koch).

Malignant oedema of animals and of man (Ehrlich).

Meat-poisoning in man (Klein).

Typhoid fever.

Malaria.

Diphtheria (Klebs).

Lepra.

\*\* Tuberculosis (including tuberculosis, phthisis, scrofula, lupus, and heart-disease of animals).

2. LEPTOTHRIX : longer rods and fibres, often occurring in bundles, and found in the saliva, etc., *L. buccalis*.

IV. SPIROBACTERIA : threads forming spirals.

1. SPIRILLUM : spirals rigid ; *S. serpens* (in stagnant fluids).

2. SPIROCHÆTA : spirals not rigid.

In the tartar, and in caries of the teeth.

\*\* *S. Obermeieri* (in relapsing fever).

Actinomyces, which is introduced into this list by Dr. Dreschfeld, is a Hyphomycete, and does not belong to this class of Fungi.

## INDEX.

The references are to the pages. The names of genera and species quoted as synonyms or mentioned in passing are printed in italics.

### A

- Acetification, 65, 85, 106
- Actinomyces*, 106
- Alcohol, 57
- Alopecia, 87
- Ammonia, 9, 15, 97
- Anthrax, 30, 106
- Aphtha, 66
- Ascobacteria, 97
- *ulvina*, *Van T.*, 97
- Ascococcus, 15, 96
- *Billrothii*, *Cohn*, 15
- *mesenteroides*, *Cien.*, 16
- *vibrans*, *Van T.*, 97

### B

- Bacillus, 26, 89
- *Amylobacter*, *Van T.*, 29, 50
- *anthracis*, *Cohn*, 30
- *beribericus*, *De Lac.*, 90
- *crassus*, *Van T.*, 89
- *erythrosporus*, *Cohn*, 33
- formation of spores, 3
- germination of spores, 4, 28
- *lepræ*, *Hansen*, 32
- *malariae*, *Tomm.*, 89
- *mollusci*, *Dom*, 89

- Bacillus* of cholera, 90
- of syphilis, 91
- *puerperalis*, *Eng.*, 89
- *ruber*, *F. et C.*, 33
- *subtilis*, *Cohn*, 3, 27
- *suis*, *Detmers*, 13
- *tremulus*, *Koch*, 28
- tuberculosis, *Koch*, 5, 45,
- 103
- *Ulna*, *Cohn*, 30
- *ureæ*, *Miquel*, 91
- *virens*, *Van T.*, 90
- Bacteria, aggregated, 96
- Bacteriaceæ, 75
- Bacteridium aurantiacum*, *Schr.*, 8
- *cyaneum*, *Schr.*, 9
- *luteum*, *Schr.*, 8
- *prodigiosum*, *Schr.*, 7
- *violaceum*, *Schr.*, 9
- Bacterio-purpurin, 18, 85
- Bacterium, 22, 75
- *aceti*, *Zopf*, 85
- *æruginosum*, *Schr.*, 26
- *chlorinum*, *Eng.*, 88
- *decalvans*, *Thin*, 87
- *foetidum*, *Thin*, 87
- *fusiforme*, *Warm.*, 25
- *griseum*, *Warm.*, 14
- *hyacinthi*, *Wakk.*, 89
- *lactis*, *Lister*, 86
- *Lineola*, *Cohn*, 24

- Bacterium litoreum*, Warm., 24  
 — *lucens*, Van T., 88  
 — *merismopedioides*, Zopf, 84,  
     95  
 — *Navicula*, R. et B., 25  
 — *photometricum*, Eng., 88  
 — *rubescens*, Lank., 17, 85  
 — *sulfuratum*, Warm., 86  
 — *syncyanum*, Schr., 26  
 — *synxanthum*, Schr., 25  
 — *Termo*, Duj., 10, 23  
 — *triloculare*, Ehr., 24  
 — *violaceum*, Gr., 26  
 — *viride*, Van T., 88  
 — *Zopfii*, Kurth, 83  
 Beer, fermentation of, 59, 61, 62  
 Beet-root sugar, 16  
 Beggiatoa, 36, 75  
 — *alba*, Trev., 36, 73  
 — — *marina*, Cohn, 37  
 — *arachnoidea*, Rab., 38  
 — *leptomitiformis*, Trev., 38  
 — *minima*, Warm., 40  
 — *mirabilis*, Cohn, 39  
 — *multiseptata*, Eng., 93  
 — *nivea*, Rab., 37  
 — *nodosa*, Van T., 92  
 — *Erstedtii*, Rab., 37  
 — *pellucida*, Cohn, 38  
 — *punctata*, Trev., 36  
 — *roseo-persicina*, Zopf, 18, 74,  
     85  
 — *tigrina*, Rab., 39  
 Beri-beri, 90  
 Blood-rain, 7  
 Blue milk, 26  
 Butyric fermentation, 28, 29

## C

- Caries of the teeth, 35, 44, 94, 106  
*Carpozyma apiculatum*, Eng., 62  
 Cellulose fermentation, 29  
 Chicken-cholera, 13, 106  
 Chinch-bug, 13  
 Chlorophyll, 88, 90  
 Cholera, 13, 90  
*Chromatium violascens*, Perty, 98  
 — *Weissii*, Perty, 20, 98

- Chromobacterium violaceum*, Berg.,  
     26  
 Chromogenous species, 5  
*Chroococcus*, 75  
*Cladothrix*, 40, 75  
 — *dichotoma*, Cohn, 41, 73  
 — *Försteri*, Wint., 41  
*Clathrocystis*, 17  
 — *aruginosa*, Henf., 17  
 — *roseo-persicina*, Cohn, 18  
*Clostridium*, 75  
 — *butyricum*, Prazm., 29  
 Coccaceæ, 75  
 Cohnia, 17  
 — *roseo-persicina*, Wint., 17,  
     74  
 Consumption, 32  
*Crenothrix*, 54, 75  
 — *Kühniana*, Zopf, 55  
 — *polyspora*, Cohn, 55  
*Cryptococcus*  
 — *cerevisia*, Kütz., 58  
 — *fermentum*, Kütz., 58  
 — *glutinis*, Fres., 63  
 — *guttulatus*, Rob., 66  
 — *xanthogenicus*, Freire, 95  
 Cultivation, Pasteur's, 78

## D

- Desmobacteria*, 69, 106  
 Diphtheria, 11, 105, 106  
 Diseases produced by Schizomy-  
     cetes, 105  
 Dispora, 92  
 — *Caucasia*, Kern, 92  
*Drilosiphon Julianus*, Zuk, 72  
 Dysentery, 106

## E

- Erysipelas, 105

## F

- Fermentation, 1, 57, 64  
 — alcoholic, 57

Fermentation, butyric, 28, 29  
 — lactic, 87  
 — of beer, 59, 61, 62  
 — of cellulose, 29  
 — of milk, 92  
 — of starch, 10  
 — of tomatoes, 62  
 — of urine, 9  
 — of wine, 60, 61, 62  
 Fire-blight, 10

## G

Gattine, 14  
 Glanders, 106  
*Glaucothrix*, 75  
*Gliotheix*, 75  
 Gonorrhoea, 105

## H

*Hæmatococcus*, 76  
 Hog-cholera, 13  
*Hormiscium*  
 — *album*, Bonord., 63  
 — *cerevisia*, Bail, 59  
 — *cerevisia*, Bonord., 64  
 — *vini*, Bonord., 64  
*Hygrocrocis Vandelli*, Men., 36  
*Hypheothrix Kühniana*, Rab., 55

## K

Kephir, 92

## L

Lactic fermentation, 87  
 Leprosy, 32, 106  
*Leptonema niveum*, Rab., 37  
*Leptothrix*, 34, 75  
 — *buccalis*, Rob., 34, 94  
 — *gigantea*, Mill., 93  
 — *Kühniana*, Rab., 55  
 — *Lanugo*, Kütz., 35  
 — *ochracea*, Kütz., 73

*Leptothrix parasitica*, Kütz., 35, 73  
 — *pusilla*, Rab., 35  
 — *subtilissima*, Rab., 90  
 — *tenuissima*, Rab., 90  
*Leuconostoc*, 16, 75  
 — *mesenterioides*, Van T., 16

## M

Malaria, 89, 106  
 Measles, 13, 105  
*Melanella flexuosa*, Bory, 47  
 — *Spirillum*, Bory, 50  
*Merismopedia*  
 — *Goodsirii*, Hus., 20  
 — *hyalina*, Kütz., 22  
 — *litoralis*, Rab., 21  
 — *urina*, Rab., 21  
 — *ventriculi*, Rob., 20  
 — *violacea*, Kütz., 22  
*Merismopedium*  
 — *chondroideum*, Wittz., 22  
 — *Reitenbachii*, Casp., 21  
 Microbacteria, 69, 106  
 Micrococcus, 6, 13, 95  
 — *amylivorus*, Burr., 10  
 — *aurantiacus*, Cohn, 8  
 — *black*, 95  
 — *bombycis*, Cohn, 12  
 — *candidus*, Cohn, 10  
 — *chlorinus*, Cohn, 8  
 — *Crepusculum*, Cohn, 10  
 — *cyaneus*, Cohn, 9  
 — *diphtheriticus*, Cohn, 11  
 — *fulvus*, Cohn, 8  
 — *gallicidus*, Burr., 13  
 — *griseus*, Wint., 14  
 — *insectorum*, Burr., 13  
 — *luteus*, Cohn, 8  
 — *ovatus*, Wint., 14  
 — *prodigiosus*, Cohn, 7  
 — *septicus*, Cohn, 12  
 — *suis*, Burr., 13  
 — *toxicatus*, Burr., 15  
 — *ureæ*, Cohn, 9  
 — *vaccinæ*, Cohn, 11  
 — *violaceus*, Cohn, 9  
*Microhaloa rosea*, Kütz., 17  
 Micro-millimetre, 101

*Microsphaera vaccinae*, Cohn, 11  
*Microsporon septicum*, Klebs, 12  
*Microzyma bombycis*, Béch., 12  
 Molluscum, 89  
 Monads, 2, 98  
 Monas, 98  
   — *Crepusculum*, Ehr., 10  
   — *erubescens*, Ehr., 86, 99  
   — *fallax*, Warm., 100  
   — *gracilis*, Warm., 86, 99  
   — *Mülleri*, Warm., 99  
   — *Okenii*, Ehr., 20, 85, 98  
   — *prodigiosa*, Ehr., 7  
   — *Termo*, Müll., 23  
   — *vinosa*, Ehr., 86, 98  
   — *Warmingii*, Cohn, 86, 99  
*Monostroma rosea*, Curr., 18  
 Mucor-ferment, 67  
 Mucorini, 76  
*Mucor Mucedo*, Linn., 80  
   — *racemosus*, Fres., 67  
*Mycoderma*  
   — *cerevisiae*, Desm., 64  
   — *vini*, Desm., 64  
*Myconostoc*, 41  
   — *gregarium*, Cohn, 42  
 Mycoprotein, 74

## N

*Nosema bombycis*, Näg., 14  
 Nudo-flagellata, 99

## O

Oedema, malignant, 91, 106  
*Oidium albicans*, Rob., 65  
*Ophidomonas*, 46  
   — *Jenensis*, Ehr., 53  
   — *sanguinea*, Ehr., 51, 53  
*Oscillaria*  
   — *alba*, Vauch., 36  
   — *arachnoidea*, Ag., 38  
   — *leptomitiformis*, Men., 38  
   — *tigrina*, Röm., 39  
   — *versatilis*, Kütz., 38

## P

*Palmella infusionum*, Ehr., 23  
   — *mirifica*, Rab., 8  
   — *prodigiosa*, Mont., 7  
*Palmellina flocculosa*, Radl., 55  
*Panhistophyton ovatum*, Leb., 14  
 Pathogenous species, 5  
 Pébrine, 14  
*Penicillium*, 77, 80  
 Phragmidiothrix, 75, 92  
   — *multiseptata*, Eng., 93  
 Phthisis, 32, 106  
 Phycochromaceae, 1, 34  
 Pleomorphy, 76, 80  
*Pleurococcus roseo-persicinus*,  
   Rab., 17  
 Pneumo-enteritis of pig, 91  
 Pneumonia, 105  
 Polybacteria  
   — *catenata*, Van T., 96  
   — *sulfurea*, Van T., 96  
 Protean species, 78, 83  
*Protococcus roseo-persicinus*, Kütz.,  
   17  
 Punctula  
   — *cubica*, Van T., 96  
   — *glomerata*, Van T., 97  
   — *rosea*, Van T., 96  
 Pus, blue, 26  
 Pustula maligna, 31  
 Putrefaction, 10, 23  
 Pyæmia, 12, 105  
 Pyorrhœa, 94

## R

Recurrent fever, 44, 106  
*Rhabdomonas*  
   — *rosea*, Cohn, 86, 100

## S

*Saccharomyces*, 58  
   — *albicans*, Reess, 65  
   — *apiculatus*, Reess, 62  
   — *cerevisiae*, Mey., 58, 67

*Saccharomyces conglomeratus*,  
*Reess*, 60  
 — *coprogenus*, *S. et S.*, 66  
 — *ellipsoideus*, *Reess*, 60  
 — *exiguus*, *Reess*, 61  
 — formation of spores, 57  
 — *glutinis*, *Cohn*, 63  
 — *guttulatus*, *Wint.*, 66  
   *minor*, *Eng.*, 59  
 — *Mycoderma*, *Reess*, 64  
 — *olei*, *Van T.*, 67  
 — *Pastorianus*, *Reess*, 61  
 — *sphaericus*, *Sacc.*, 62  
*Saccharomycetes*, 57, 79  
*Sarcina*, 20, 95  
 — *hyalina*, *Wint.*, 22  
 — *litoralis*, *Wint.*, 21  
 — *Reitenbachii*, *Wint.*, 21  
 — *renis*, *Hepworth*, 22  
 — *solani*, *R. et B.*, 95  
 — *urinae*, *Welck.*, 21  
   *ventriculi*, *Good.*, 20  
*Scarlet fever*, 13, 105  
*Schizomycetes*, 1, 68  
*Schizophyceæ*, 76  
*Schizophytæ*, 1, 70  
*Schlafsucht*, 12  
*Scrofula*, 106  
*Septicæmia*, 12, 105, 106  
*Silkworm disease*, 12, 14  
*Small-pox*, 11, 105  
*Sphærobacteria*, 69, 105  
*Sphærotilus*, 53  
   *natans*, *Kütz.*, 53, 56  
   *ochraceus*, *Bréb.*, 54  
*Spirillum*, 46, 94  
 — *amyliferum*, *Van T.*, 50  
 — *attenuatum*, *Warm.*, 52  
 — *Jenense*, *Wint.*, 53  
 — *plicatile*, *Duj.*, 43  
 — *rosaceum*, *Klein*, 94  
 — *Rosenbergii*, *Warm.*, 52  
 — *rufum*, *Perty*, 94  
 — *Rugula*, *Wint.*, 47  
 — *sanguineum*, *Cohn*, 51, 94  
 — *serpens*, *Wint.*, 47  
 — *tenue*, *Ehr.*, 43, 48  
 — *Undula*, *Ehr.*, 42, 49, 94  
   *litorale*, *Warm.*, 49  
 — *violaceum*, *Warm.*, 52

*Spirillum volutans*, *Ehr.*, 50  
 — *robustum*, *Warm.*, 51  
*Spirobacteria*, 70, 106  
*Spirochæta*, 43  
 — *Cohnii*, *Wint.*, 44  
 — *gigantea*, *Warm.*, 45  
 — *Obermeieri*, *Cohn*, 43  
 — *plicatilis*, *Ehr.*, 43  
*Spirochæte*  
   *denticola*, *Arn.*, 44  
   *dentium*, *Mill.*, 44  
*Spiromonas*, 45  
 — *Cohnii*, *Warm.*, 46  
 — *volubilis*, *Perty*, 45  
*Spirulina*, 43, 94  
 — *alba*, *Van T.*, 94  
 — *plicatilis*, *Cohn*, 43  
 — *tenuissima*, *Kütz.*, 94  
*Splenic fever*, 31, 106  
*Spores*, germination of, 3, 17, 28  
 — reproduction by, 3, 57, 74  
*Sporonema gracile*, *Perty*, 90  
*Staining fluids*, 103  
*Starch*, fermentation of, 10  
 — in fungi, 29, 50  
*Streptococcus*, 70  
*Streptothrix*, 40  
   *Försteri*, *Cohn*, 41  
*Symphyothrix nivea*, *Brüg.*, 38  
*Syphilis*, 13, 91, 106

## T

*Teeth*, decay of, 35, 44, 47, 94,  
 106  
*Thrush*, 66  
*Torula*, 32, 67, 73  
   *cerevisia*, *Turp.*, 58  
*Tuberculosis*, 32, 106  
*Typhoid*, 106  
*Typhus*, 13, 105

## U

*Unit of measurement*, 7, 101  
*Urine*, 9, 21, 91  
*Ustilaginæ*, 80

## V

- Variola, 11, 105  
*Vibrio*, 46, 69  
 — *cyanogenus*, Fuchs, 26  
 — *Lincola*, Müll., 24  
 — *prolifer*, Ehr., 49  
 — *Rugula*, Müll., 47  
 — *serpens*, Müll., 47  
 — *Spirillum*, Müll., 50  
 — *subtilis*, Ehr., 27  
 — *syncyanus*, Ehr., 26  
 — *synxanthus*, Ehr., 25  
 — *tremulans*, Ehr., 24  
 — *Undula*, Müll., 49  
 — *xanthogenus*, Fuchs, 25  
*Vibrion butyrique*, 29  
 Vinegar, formation of, 65, 85, 106  
*Volvox punctum*, Müll., 99

## W.

- Woolsorters' disease, 31

## Y

- Yeast, 59, 60  
 Yeast Fungi (*see* *Saccharomycetes*)  
 Yellow fever, 95  
 Yellow milk, 25

## Z

- Zoogalactina imetrophia*, Sette, 7  
 Zoogloea, 3  
*Zoogloea Termo*, Cohn, 23  
 Zymogenous species, 5

[March, 1884.]



## CHATTO & WINDUS'S *LIST OF BOOKS.*

---

**About.**—*The Fella*: An Egyptian Novel. By EDMOND ABOUT. Translated by Sir RANDAL ROBERTS. Post 8vo, illustrated boards, 2s. ; cloth limp, 2s. 6d.

**Adams (W. Davenport), Works by:**

**A Dictionary of the Drama.** Being a comprehensive Guide to the Plays, Playwrights, Players, and Playhouses of the United Kingdom and America, from the Earliest to the Present Times. Crown 8vo, half-bound, 12s. 6d.

**Latter-Day Lyrics.** Edited by W. DAVENPORT ADAMS. Post 8vo, cloth limp, 2s. 6d.

**Quips and Quiddities.** Selected by W. DAVENPORT ADAMS. Post 8vo, cloth limp, 2s. 6d.

**Advertising, A History of,** from the Earliest Times. Illustrated by Anecdotes, Curious Specimens, and Notices of Successful Advertisers. By HENRY SAMPSON. Crown 8vo, with Coloured Frontispiece and Illustrations, cloth gilt, 7s. 6d.

**Agony Column (The) of "The Times,"** from 1800 to 1870. Edited, with an Introduction, by ALICE CLAY. Post 8vo, cloth limp, 2s. 6d.

**Aide (Hamilton), Works by:**  
**Carr of Carryon.** Post 8vo, illustrated boards, 2s.

**Confidences.** Post 8vo, illustrated boards, 2s.

**Alexander (Mrs.).—Maid, Wife, or Widow?** A Romance. By Mrs. ALEXANDER. Post 8vo, illustrated boards, 2s. ; cr. 8vo, cloth extra, 3s. 6d.

**Allen (Grant), Works by:**

**Collin Clout's Calendar.** Crown 8vo, cloth extra, 6s.

**The Evolutionist at Large.** Crown 8vo, cloth extra, 6s.

**Vignettes from Nature.** Crown 8vo, cloth extra, 6s.

**Architectural Styles, A Handbook of.** Translated from the German of A. ROSENGARTEN, by W. COLLETT-SANDARS. Crown 8vo, cloth extra, with 639 Illustrations, 7s. 6d.

**Art (The) of Amusing:** A Collection of Graceful Arts, Games, Tricks, Puzzles, and Charades. By FRANK BELLEW. With 300 Illustrations. Cr. 8vo, cloth extra, 4s. 6d.

**Artemus Ward:**

**Artemus Ward's Works:** The Works of CHARLES FARRER BROWNE, better known as ARTEMUS WARD. With Portrait and Facsimile. Crown 8vo, cloth extra, 7s. 6d.

**Artemus Ward's Lecture on the Mormons.** With 32 Illustrations. Edited, with Preface, by EDWARD P. HINGSTON. Crown 8vo, 6d.

**The Genial Showman:** Life and Adventures of Artemus Ward. By EDWARD P. HINGSTON. With a Frontispiece. Crown 8vo, cloth extra, 3s. 6d.

**Ashton (John), Works by:**

**A History of the Chap-Books of the Eighteenth Century.** With nearly 400 Illusts., engraved in facsimile of the originals. Cr. 8vo, cl. ex., 7s. 6d.

**Social Life in the Reign of Queen Anne.** From Original Sources. With nearly 100 Illusts. Cr. 8vo, cl. ex., 7s. 6d.

**Humour, Wit, and Satire of the Seventeenth Century.** With nearly 100 Illusts. Cr. 8vo, cl. extra, 7s. 6d.

**English Caricature and Satire on Napoleon the First.** With 120 Illustrations from the Originals. Two Vols., demy 8vo, 28s. [*In preparation.*]

**Bacteria.**—A Synopsis of the Bacteria and Yeast Fungi and Allied Species. By W. B. GROVE, B.A. With over 100 Illustrations. Cr. 8vo, cloth extra, 3s. 6d. [*In preparation.*]

**Balzac's "Comedie Humaine"** and its Author. With Translations by H. H. WALKER. Post 8vo, cl. limp, 2s. 6d.

**Bankers, A Handbook of London;** together with Lists of Bankers from 1677. By F. G. HILTON PRICE. Crown 8vo, cloth extra, 7s. 6d.

**Bardsley (Rev. C.W.), Works by:**  
**English Surnames: Their Sources and Significations.** Cr. 8vo, cl. extra, 7s. 6d.

**Curiosities of Puritan Nomenclature.** Crown 8vo, cloth extra, 7s. 6d.

**Bartholomew Fair, Memoirs of.** By HENRY MORLEY. With 100 Illusts. Crown 8vo, cloth extra, 7s. 6d.

**Beauchamp. — Grantley Grange: A Novel.** By SHELLEY BEAUCHAMP. Post 8vo, illust. bds., 2s.

**Beautiful Pictures by British Artists:** A Gathering of Favourites from our Picture Galleries. In Two Series. All engraved on Steel in the highest style of Art. Edited, with Notices of the Artists, by SYDNEY ARMYTAGE, M.A. Imperial 4to, cloth extra, gilt and gilt edges, 21s. per Vol.

**Böckstein. — As Pretty as Seven,** and other German Stories. Collected by LUDWIG BECKSTEIN. With Additional Tales by the Brothers GRIMM, and 100 Illusts. by RICHTER. Small 4to, green and gold, 6s. 6d.; gilt edges, 7s. 6d.

**Börberholm. — Wanderings in Patagonia;** or, Life among the Ostrich Hunters. By JULIUS BEERBOHM. With Illusts. Crown 8vo, cloth extra, 3s. 6d.

**Belgravia for 1884.** One Shilling Monthly, Illustrated by P. MACNAD. — Two Serial Stories are now appearing in this Magazine: "The Lover's Creed," by Mrs. CASHEL HOEY; and "The Wearing of the Green," by the Author of "Love the Debt."

\* \* \* Now ready, the Volume for NOVEMBER, 1883, to FEBRUARY, 1884, cloth extra, gilt edges, 7s. 6d.; Cases for binding Vols., 2s. each.

**Belgravia Holiday Number.** With Stories by JAMES PAYN, F. W. ROBINSON, J. ARBUTHNOT WILSON, and others. Demy 8vo, with Illustrations, 1s. [*Preparing.*]

**Bennett (W.C., LL.D.), Works by:**  
**A Ballad History of England.** Post 8vo, cloth limp, 2s.

**Songs for Sailors.** Post 8vo, cloth limp, 2s.

**Besant (Walter) and James Rice, Novels by.** Post 8vo, illust. boards, 2s. each; cloth limp, 2s. 6d. each; or crown 8vo, cloth extra, 3s. 6d. each.

**Ready-Money Mortiboy.**

**With Harp and Crown.**

**This Son of Vulcan.**

**My Little Girl.**

**The Case of Mr. Lucraft.**

**The Golden Butterfly.**

**By Celia's Arbour.**

**The Monks of Thelama.**

**'Twas in Trafalgar's Bay.**

**The Seamy Side.**

**The Ten Years' Tenant.**

**The Chaplain of the Fleet.**

**Besant (Walter), Novels by:**

**All Sorts and Conditions of Men:** An Impossible Story. With Illustrations by FRED. BARNARD. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**The Captains' Room, &c.** With Frontispiece by B. J. WHEELER. Crown 8vo, cloth extra, 2s. 6d.; post 8vo, illustrated boards, 2s.

**All in a Garden Fair.** Three Vols., crown 8vo.

**Dorothy Forster.** Three Vols., crown 8vo. [*Shortly.*]

**Betham-Edwards (M.), Novels by.** Crown 8vo, cloth extra, 3s. 6d. each; post 8vo, illust. bds., 2s. each.  
Felicia. | Kitty.

**Bewick (Thomas) & his Pupils.**

By AUSTIN DORSON. With 100 Illustrations. Square 8vo, cloth extra, 10s. 6d. [Preparing.]

**Birthday Books:—**

**The Starry Heavens:** A Poetical Birthday Book. Square 8vo, handsomely bound in cloth, 2s. 6d.

**Birthday Flowers:** Their Language and Legends. By W. J. GORDON. Beautifully Illustrated in Colours by VIOLA BOUGHTON. In illuminated cover, crown 4to, 6s.

**The Lowell Birthday Book.** With Illusts., small 8vo, cloth extra, 4s. 6d.

**Bishop.—Old Mexico and her**

**Lost Provinces.** By WILLIAM HENRY BISHOP. With 120 Illustrations. Demy 8vo, cloth extra, 10s. 6d.

**Blackburn's (Henry) Art Hand-**

**books.** Demy 8vo, Illustrated, uniform in size for binding.

**Academy Notes,** separate years, from 1875 to 1883, each 1s.

**Academy Notes, 1884.** With Illustrations. 1s. [Preparing.]

**Academy Notes, 1875-79.** Complete in One Vol., with nearly 600 Illusts. in Facsimile. Demy 8vo, cloth limp, 6s.

**Grosvenor Notes, 1877.** 6d.

**Grosvenor Notes,** separate years, from 1878 to 1883, each 1s.

**Grosvenor Notes, 1884.** With Illustrations. 1s. [Preparing.]

**Grosvenor Notes, 1877-82.** With upwards of 300 Illustrations. Demy 8vo, cloth limp, 6s.

**Pictures at South Kensington.** With 70 Illustrations. 1s.

**The English Pictures at the National Gallery.** 114 Illustrations. 1s.

**The Old Masters at the National Gallery.** 125 Illustrations. 1s. 6d.

**A Complete Illustrated Catalogue to the National Gallery.** With Notes by H. BLACKBURN, and 242 Illusts. Demy 8vo, cloth limp, 3s.

**The Paris Salon, 1884.** With over 300 Illusts. Edited by F. G. DUMAS. Demy 8vo, 3s. [Preparing.]

**The Art Annual, 1883-4.** Edited by F. G. DUMAS. With 300 full-page Illustrations. Demy 8vo, 6s.

**Boccaccio's Decameron; or,**

**Ten Days' Entertainment.** Translated into English, with an Introduction by THOMAS WRIGHT, F.S.A. With Portrait, and STOTHARD'S beautiful Copperplates. Cr. 8vo, cloth extra, gilt, 7s. 6d.

**Blake (William): Etchings from**

his Works. By W. B. SCOTT. With descriptive Text. Folio, half-bound boards, India Proofs, 21s.

**Bowers (G.) Hunting Sketches:**

**Canter in Crampshire.** Oblong 4to, half-bound boards, 21s.

**Leaves from a Hunting Journal.** Coloured in facsimile of the originals. Oblong 4to, half-bound, 21s.

**Boyle (Frederick), Works by:**

**Camp Notes:** Stories of Sport and Adventure in Asia, Africa, and America. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated bds., 2s.

**Savage Life.** Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated bds., 2s.

**Brand's Observations on Pop-**

**ular Antiquities,** chiefly Illustrating the Origin of our Vulgar Customs, Ceremonies, and Superstitions. With the Additions of Sir HENRY ELLIS. Crown 8vo, cloth extra, gilt, with numerous Illustrations, 7s. 6d.

**Bret Harte, Works by:**

**Bret Harte's Collected Works.** Arranged and Revised by the Author. Complete in Five Vols., crown 8vo, cloth extra, 6s. each.

Vol. I. COMPLETE POETICAL AND DRAMATIC WORKS. With Steel Portrait, and Introduction by Author.

Vol. II. EARLIER PAPERS—LUCK OF ROARING CAMP, and other Sketches—BOHEMIAN PAPERS—SPANISH AND AMERICAN LEGENDS.

Vol. III. TALES OF THE ARGONAUTS—EASTERN SKETCHES.

Vol. IV. GABRIEL CONROY.

Vol. V. STORIES—CONDENSED NOVELS, &c.

**The Select Works of Bret Harte,** in Prose and Poetry. With Introductory Essay by J. M. BELLEW, Portrait of the Author, and 50 Illustrations. Crown 8vo, cloth extra, 7s. 6d.

**Gabriel Conroy:** A Novel. Post 8vo, illustrated boards, 2s.

**An Heiress of Red Dog,** and other Stories. Post 8vo, illustrated boards, 2s.; cloth limp, 2s. 6d.

**The Twins of Table Mountain.** Fcap. 8vo, picture cover, 1s.; crown 8vo, cloth extra, 3s. 6d.

**Luck of Roaring Camp,** and other Sketches. Post 8vo, illust. bds., 2s.

**Jeff Briggs's Love Story.** Fcap. 8vo, picture cover, 1s.; cloth extra, 2s. 6d.

**Flip.** Post 8vo, illustrated boards, 2s.; cloth limp, 2s. 6d.

**Californian Stories** (including THE TWINS OF TABLE MOUNTAIN, JEFF BRIGGS'S LOVE STORY, &c.) Post 8vo, illustrated boards, 2s.

**Brewer (Rev. Dr.), Works by :**

**The Reader's Handbook of Allusions, References, Plots, and Stories.** Third Edition, revised throughout, with a New Appendix, containing a COMPLETE ENGLISH BIBLIOGRAPHY. Cr. 8vo, 1,400 pp., cloth extra, 7s. 6d.

**A Dictionary of Miracles:** Imitative, Realistic, and Dogmatic. Crown 8vo, cloth extra, 7s. 6d. [*Immediately.*]

**Brewster (Sir David), Works by :**

**More Worlds than One:** The Creed of the Philosopher and the Hope of the Christian. With Plates. Post 8vo, cloth extra, 4s. 6d.

**The Martyrs of Science:** Lives of GALILEO, TYCHO BRAHE, and KEPLER. With Portraits. Post 8vo, cloth extra, 4s. 6d.

**Letters on Natural Magic.** A New Edition, with numerous illustrations, and Chapters on the Being and Faculties of Man, and Additional Phenomena of Natural Magic, by J. A. SMITH. Post 8vo, cloth extra, 4s. 6d.

**Brillat-Savarin.—Gastronomy**

as a Fine Art. By BRILLAT-SAVARIN. Translated by R. E. ANDERSON, M.A. Post 8vo, cloth limp, 2s. 6d.

**Browning.—The Pied Piper of**

Hamelin. By ROBERT BROWNING. Illust. by GEORGE CARLINE. Large 4to, illuminated cover, 1s.

[*In preparation.*]

**Burnett (Mrs.), Novels by :**

**Surly Tim, and other Stories.** Post 8vo, illustrated boards, 2s.

**Kathleen Mavourneen.** Fcap. 8vo, picture cover, 1s.

**Lindsay's Luck.** Fcap. 8vo, picture cover, 1s.

**Pretty Polly Pemberton.** Fcap. 8vo picture cover, 1s.

**Burton (Captain), Works by :**

**To the Gold Coast for Gold:** A Personal Narrative. By RICHARD F. BURTON and VERNEY LOVETT CAMERON. With Maps and Frontispiece. Two Vols., crown 8vo, cloth extra, 21s.

**The Book of the Sword:** Being a History of the Sword and its Use in all Countries, from the Earliest Times. By RICHARD F. BURTON. With over 400 illustrations. Square 8vo, cloth extra, 32s.

**Buchanan's (Robert) Works :**

**Ballads of Life, Love, and Humour.** With a Frontispiece by ARTHUR HUGHES. Crown 8vo, cloth extra, 6s.

**Selected Poems of Robert Buchanan.** With Frontispiece by T. DALZIEL. Crown 8vo, cloth extra, 6s.

**Undertones.** Cr. 8vo, cloth extra, 6s.

**London Poems.** Crown 8vo, cloth extra, 6s.

**The Book of Orm.** Crown 8vo, cloth extra, 6s.

**White Rose and Red: A Love Story.** Crown 8vo, cloth extra, 6s.

**Idylls and Legends of Inverburn.** Crown 8vo, cloth extra, 6s.

**St. Abe and his Seven Wives: A Tale of Salt Lake City.** With a Frontispiece by A. B. HOUGHTON. Crown 8vo, cloth extra, 6s.

**The Hebridean Isles: Wanderings in the Land of Lorne and the Outer Hebrides.** With Frontispiece by W. SMALL. Crown 8vo, cloth extra, 6s.

**A Poet's Sketch-Book:** Selections from the Prose Writings of ROBERT BUCHANAN. Crown 8vo, cl. extra, 6s.

**The Shadow of the Sword: A Romance.** Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illust. boards, 2s.

**A Child of Nature: A Romance.** With a Frontispiece. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illust. bds., 2s.

**God and the Man: A Romance.** With illustrations by FRED. BARNARD. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**The Martyrdom of Madeline: A Romance.** With Frontispiece by A. W. COOPER. Cr. 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Love Me for Ever.** With a Frontispiece by P. MACNAB. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Annan Water: A Romance.** Three Vols., crown 8vo.

**The New Abelard: A Romance.** Three Vols., crown 8vo.

**Foxglove Manor: A Novel.** Three Vols., crown 8vo. [*In preparation.*]

**Robert Buchanan's Complete Poetical Works.** With Steel-Plate Portrait. Crown 8vo, cloth extra, 7s. 6d.

[*In the press.*]

**Burton (Robert) :**

**The Anatomy of Melancholy.** A New Edition, complete, corrected and enriched by Translations of the Classical Extracts. Demy 8vo, cloth extra, 7s. 6d.

**Melancholy Anatomised:** Being an Abridgment, for popular use, of BURTON'S ANATOMY OF MELANCHOLY. Post 8vo, cloth limp, 2s. 6d.

**Bunyan's Pilgrim's Progress.**

Edited by Rev. T. SCOTT. With 17 Steel Plates by STOTHARD, engraved by GOODALL, and numerous Woodcuts. Crown 8vo, cloth extra, gilt, 7s. 6d.

**Byron (Lord):**

**Byron's Letters and Journals.** With Notices of his Life. By THOMAS MOORE. A Reprint of the Original Edition, newly revised, with Twelve full-page Plates. Crown 8vo, cloth extra, gilt, 7s. 6d.

**Byron's Don Juan.** Complete in One Vol., post 8vo, cloth limp, 2s.

**Cameron (Commander) and**

**Captain Burton.—To the Gold Coast for Gold: A Personal Narrative.** By RICHARD F. BURTON and VERNY LOVETT CAMERON. With Frontispiece and Maps. Two Vols., crown 8vo, cloth extra, 21s.

**Cameron (Mrs. H. Lovett),**  
Novels by:

**Juliet's Guardian.** Post 8vo, illustrated boards, 2s.; crown 8vo, cloth extra, 3s. 6d.

**Deceivers Ever.** Post 8vo, illustrated boards, 2s.; crown 8vo, cloth extra, 3s. 6d.

**Campbell.—White and Black:**

**Travels in the United States.** By Sir GEORGE CAMPBELL, M.P. Demy 8vo, cloth extra, 14s.

**Carlyle (Thomas):**

**Thomas Carlyle: Letters and Recollections.** By MONCURE D. CONWAY, M.A. Crown 8vo, cloth extra, with Illustrations, 6s.

**On the Choice of Books.** By THOMAS CARLYLE. With a Life of the Author by R. H. SHEPHERD. New and Revised Edition, post 8vo, cloth extra, Illustrated, 1s. 6d.

**The Correspondence of Thomas Carlyle and Ralph Waldo Emerson, 1834 to 1872.** Edited by CHARLES ELIOT NORTON. With Portraits. Two Vols., own 8vo, cloth extra, 24s.

**Chapman's (George) Works:**

Vol. I. contains the Plays complete, including the doubtful ones. Vol. II., the Poems and Minor Translations, with an Introductory Essay by ALGERNON CHARLES SWINBURNE. Vol. III., the Translations of the Iliad and Odyssey. Three Vols., crown 8vo, cloth extra, 18s.; or separately, 6s. each.

**Chatto & Jackson.—A Treatise**

on Wood Engraving, Historical and Practical. By WM. ANDREW CHATTO and JOHN JACKSON. With an Additional Chapter by HENRY G. BOHM; and 450 fine Illustrations. A Reprint of the last Revised Edition. Large 4to, half-bound, 28s.

**Chaucer:**

**Chaucer for Children: A Golden Key.** By Mrs. H. R. HAWES. With Eight Coloured Pictures and numerous Woodcuts by the Author. New Ed., small 4to, cloth extra, 6s.

**Chaucer for Schools.** By Mrs. H. R. HAWES. Demy 8vo, cloth limp, 2s. 6d.

**City (The) of Dream: A Poem.**

Fcap. 8vo, cloth extra, 6s. [*In the press.*]

**Cobban.—The Cure of Souls:**

**A Story.** By J. MACLAREN COBBAN. Post 8vo, illustrated boards, 2s.

**Collins (C. Allston).—The Bar**

**Sinister: A Story.** By C. ALLSTON COLLINS. Post 8vo, illustrated boards, 2s.

**Collins (Mortimer & Frances),**

Novels by:

**Sweet and Twenty.** Post 8vo, illustrated boards, 2s.

**Frances.** Post 8vo, illust. bds., 2s.

**Blacksmith and Scholar.** Post 8vo, illustrated boards, 2s.; crown 8vo cloth extra, 3s. 6d.

**The Village Comedy.** Post 8vo, illust. boards, 2s.; cr. 8vo, cloth extra, 3s. 6d.

**You Play Me False.** Post 8vo, illust. boards, 2s.; cr. 8vo, cloth extra, 3s. 6d.

**Collins (Mortimer), Novels by:**

**Sweet Anne Page.** Post 8vo, illustrated boards, 2s.; crown 8vo, cloth extra, 3s. 6d.

**Transmigration.** Post 8vo, illustrated boards, 2s.; crown 8vo, cloth extra, 3s. 6d.

**From Midnight to Midnight.** Post 8vo, illustrated boards, 2s.; crown 8vo, cloth extra, 3s. 6d.

**A Flight with Fortune.** Post 8vo, illustrated boards, 2s.

**Colman's Humorous Works:**

"Broad Grins," "My Nightgown and Slippers," and other Humorous Works, Prose and Poetical, of GEORGE COLMAN. With Life by G. B. BUCKSTONE, and Frontispiece by HOGARTH. Crown 8vo, cloth extra, gilt, 7s. 6d.

**Collins (Wilkie), Novels by.**

Each post 8vo, illustrated boards, 2s.; cloth limp, 2s. 6d.; or crown 8vo, cloth extra, illustrated, 3s. 6d.

**Antonina.** Illust. by A. CONCANEN.

**Basil.** Illustrated by Sir JOHN GILBERT and J. MAHONEY.

**Hide and Seek.** Illustrated by Sir JOHN GILBERT and J. MAHONEY.

**The Dead Secret.** Illustrated by Sir JOHN GILBERT and A. CONCANEN.

**Queen of Hearts.** Illustrated by Sir JOHN GILBERT and A. CONCANEN.

**My Miscellanies.** With Illustrations by A. CONCANEN, and a Steel-plate Portrait of WILKIE COLLINS.

**The Woman in White.** With Illustrations by Sir JOHN GILBERT and F. A. FRASER.

**The Moonstone.** With Illustrations by G. DU MAURIER and F. A. FRASER.

**Man and Wife.** Illust. by W. SMALL.

**Poor Miss Finch.** Illustrated by G. DU MAURIER and EDWARD HUGHES.

**Miss or Mrs. P.** With Illustrations by S. L. FILDES and HENRY WOODS.

**The New Magdalen.** Illustrated by G. DU MAURIER and C. S. RANDES.

**The Frozen Deep.** Illustrated by G. DU MAURIER and J. MAHONEY.

**The Law and the Lady.** Illustrated by S. L. FILDES and SYDNEY HALL.

**The Two Destinies.**

**The Haunted Hotel.** Illustrated by ARTHUR HOPKINS.

**The Fallen Leaves.**

**Jezebel's Daughter.**

**The Black Robe.**

**Heart and Solence: A Story of the Present Time.** New and Cheaper Edition. Crown 8vo, cloth extra, 3s. 6d.

**Convalescent Cookery: A**

Family Handbook. By CATHERINE RYAN. Post 8vo, cloth limp, 2s. 6d.

**Conway (Moncure D.), Works by:**

**Demonology and Devil-Lore.** Two Vols., royal 8vo, with 65 illusts., 28s.

**A Necklace of Stories.** Illustrated by W. J. HENNESSY. Square 8vo, cloth extra, 6s.

**The Wandering Jew.** Crown 8vo, cloth extra, 6s.

**Thomas Carlyle: Letters and Recollections.** With Illustrations. Crown 8vo, cloth extra, 6s.

**Cook (Dutton), Works by:**

**Hours with the Players.** With a Steel Plate Frontispiece. New and Cheaper Edit., cr. 8vo, cloth extra, 6s.

**Nights at the Play: A View of the English Stage.** New and Cheaper Edition. Crown 8vo, cloth extra, 6s.

**Leo: A Novel.** Post 8vo, illustrated boards, 2s.

**Paul Foster's Daughter.** Post 8vo, illustrated boards, 2s.; crown 8vo, cloth extra, 3s. 6d.

**Copyright. — A Handbook of**

English and Foreign Copyright in Literary and Dramatic Works. By SIDNEY JERROLD, of the Middle Temple, Esq., Barrister-at-Law. Post 8vo, cloth limp, 2s. 6d.

**Cornwall.—Popular Romances**

of the West of England; or, The Drolls, Traditions, and Superstitions of Old Cornwall. Collected and Edited by ROBERT HUNT, F.R.S. New and Revised Edition, with Additions, and Two Steel-plate Illustrations by GEORGE CRUIKSHANK. Crown 8vo, cloth extra, 7s. 6d.

**Creasy.—Memoirs of Eminent**

Etonians: with Notices of the Early History of Eton College. By Sir EDWARD CREASY, Author of "The Fifteen Decisive Battles of the World." Crown 8vo, cloth extra, gilt, with 13 Portraits, 7s. 6d.

**Cruikshank (George):**

**The Comic Almanack.** Complete in Two SERIES: The First from 1835 to 1843; the Second from 1844 to 1853. A Gathering of the Best HUMOUR OF THACKERAY, HOOD, MAYHEW, ALBERT SMITH, A'BECKYTT, ROBERT BROUGH, &c. With 2,000 Woodcuts and Steel Engravings by CRUIKSHANK, HINE, LANDRELLS, &c. Crown 8vo, cloth gilt, two very thick volumes, 7s. 6d. each.

**The Life of George Cruikshank.** By BLANCHARD JERROLD, Author of "The Life of Napoleon III., &c. With 84 Illustrations. New and Cheaper Edition, enlarged, with Additional Plates, and a very carefully compiled Bibliography. Crown 8vo, cloth extra, 7s. 6d.

**Robinson Crusoe.** A choicely-printed Edition, with 37 Woodcuts and Two Steel Plates by GEORGE CRUIKSHANK. Crown 8vo, cloth extra, 7s. 6d. 100 Large Paper copies, carefully printed on hand-made paper, with India proofs of the Illustrations, price 36s.

**Cussans.**—Handbook of Heraldry; with Instructions for Tracing Pedigrees and Deciphering Ancient MSS., &c. By JOHN E. CUSSANS. Entirely New and Revised Edition, illustrated with over 400 Woodcuts and Coloured Plates. Crown 8vo, cloth extra, 7s. 6d.

**Cyples.**—Hearts of Gold: A Novel. By WILLIAM CYPLES. Crown 8vo, cloth extra, 3s. 6d.

**Daniel.**—Merrie England in the Olden Time. By GEORGE DANIEL. With Illustrations by ROBT. CRUIKSHANK. Crown 8vo, cloth extra, 3s. 6d.

**Daudet.**—Port Salvation; or, The Evangelist. By ALPHONSE DAUDET. Translated by C. HARRY MELTZER. With Portrait of the Author. Crown 8vo, cloth extra, 3s. 6d.

**Davenant.**—What shall my Son be? Hints for Parents on the Choice of a Profession or Trade for their Sons. By FRANCIS DAVENANT, M.A. Post 8vo, cloth limp, 2s. 6d.

**Davies (Dr. N. E.).** Works by:  
One Thousand Medical Maxims. Crown 8vo, 1s.; cloth, 1s. 6d.  
Nursery Hints: A Mother's Guide. Crown 8vo, 1s.; cloth, 1s. 6d.

**Davies' (Sir John) Complete** Poetical Works, including Psalms I. to L. in Verse, and other hitherto Unpublished MSS., for the first time Collected and Edited, with Memorial-Introduction and Notes, by the Rev. A. B. GROSART, D.D. Two Vols., crown 8vo, cloth boards, 12s.

**De Maistre.**—A Journey Round My Room. By XAVIER DE MAISTRE. Translated by HENRY ATTWELL. Post 8vo, cloth limp, 2s. 6d.

**De Mille.**—A Castle in Spain. A Novel. By JAMES DE MILLE. With a Frontispiece. Crown 8vo, cloth extra, 3s. 6d.

**Derwent (Leith),** Novels by:  
Our Lady of Tears. Cr. 8vo, cloth extra, 3s. 6d.; post 8vo, illust. bds., 2s.  
Circe's Lovers. Crown 8vo, cloth extra, 3s. 6d.

**Dickens (Charles),** Novels by:  
Post 8vo, illustrated boards, 2s. each.  
Sketches by Boz. | Nicholas Nickleby.  
Pickwick Papers. | Oliver Twist.

The Speeches of Charles Dickens. (Mayfair Library.) Post 8vo, cloth limp, 2s. 6d.

The Speeches of Charles Dickens, 1841-1870. With a New Bibliography, revised and enlarged. Edited and Prefaced by RICHARD HERNE SHEPHERD. Crown 8vo, cloth extra, 6s.

About England with Dickens. By ALFRED KIMMER. With 57 Illustrations by C. A. VANDERHOOF, ALFRED KIMMER, and others. Sq. 8vo, cloth extra, 10s. 6d.

#### Dictionaries:

A Dictionary of Miracles: Imitative, Realistic, and Dogmatic. By the Rev. E. C. BREWER, LL.D. Crown 8vo, cloth extra, 7s. 6d. [Immediately.]

A Dictionary of the Drama: Being a comprehensive Guide to the Plays, Playwrights, Players, and Playhouses of the United Kingdom and America, from the Earliest to the Present Times. By W. DAVENPORT ADAMS. A thick volume, crown 8vo, half-bound, 12s. 6d. [In preparation.]

Familiar Allusions: A Handbook of Miscellaneous Information; including the Names of Celebrated Statues, Paintings, Palaces, Country Seats, Ruins, Churches, Ships, Streets, Clubs, Natural Curiosities, and the like. By WM. A. WHEELER and CHARLES G. WHEELER. Demy 8vo, cloth extra, 7s. 6d.

The Reader's Handbook of Allusions, References, Plots, and Stories. By the Rev. E. C. BREWER, LL.D. Third Edition, revised throughout, with a New Appendix, containing a Complete English Bibliography. Crown 8vo, 1,400 pages, cloth extra, 7s. 6d.

Short Sayings of Great Men. With Historical and Explanatory Notes. By SAMUEL A. BENT, M.A. Demy 8vo, cloth extra, 7s. 6d.

The Slang Dictionary: Etymological, Historical, and Anecdotal. Crown 8vo, cloth extra, 6s. 6d.

Words, Facts, and Phrases: A Dictionary of Curious, Quaint, and Out-of-the-Way Matters. By ELIEZER EDWARDS. Crown 8vo, half-bound, 12s. 6d.

**Dobson (W. T.), Works by :**

Literary Frivolities, Fancies, Follies, and Frolics. Post 8vo, cloth limp, 2s. 6d.

Poetical Ingeniuties and Eccentricities. Post 8vo, cloth limp, 2s. 6d.

**Doran. — Memories of our Great Towns;** with Anecdotic Gleanings concerning their Worthies and their Oddities. By Dr. JOHN DORAN, F.S.A. With 38 Illustrations. New and Cheaper Edition, crown 8vo, cloth extra, 7s. 6d.

**Drama, A Dictionary of the.**

Being a comprehensive Guide to the Plays, Playwrights, Players, and Playhouses of the United Kingdom and America, from the Earliest to the Present Times. By W. DAVENPORT ADAMS. (Uniform with BREWER'S "Reader's Handbook.") Crown 8vo, half-bound, 12s. 6d. *(In preparation.)*

**Dramatists, The Old.** Crown 8vo, cloth extra, with Vignette Portraits, 6s. per Vol.

**Ben Jonson's Works.** With Notes Critical and Explanatory, and a Biographical Memoir by WM. GIFFORD. Edited by Colonel CUNNINGHAM. Three Vols.

**Chapman's Works.** Complete in Three Vols. Vol. I. contains the Plays complete, including the doubtful ones; Vol. II., the Poems and Minor Translations, with an Introductory Essay by ALGERNON CHAS. SWINBURNE; Vol. III., the Translations of the Iliad and Odyssey.

**Marlowe's Works.** Including his Translations. Edited, with Notes and Introduction, by Col. CUNNINGHAM. One Vol.

**Massinger's Plays.** From the Text of WILLIAM GIFFORD. Edited by Col. CUNNINGHAM. One Vol.

**Dyer. — The Folk-Lore of Plants.** By T. F. TRISELTON DYER, M.A., &c. Crown 8vo, cloth extra, 7s. 6d. *(In preparation.)*

**Edwardes (Mrs. A.), Novels by :** A Point of Honour. Post 8vo, illustrated boards, 2s.

Archie Lovell. Post 8vo, illust. bds., 2s.; crown 8vo, cloth extra, 3s. 6d.

**Eggleston. — Roxy: A Novel.** By EDWARD EGGLESTON. Post 8vo, illust. boards, 2s.; cr. 8vo, cloth extra, 3s. 6d.

**Early English Poets.** Edited, with Introductions and Annotations, by Rev. A. B. GROSART, D.D. Crown 8vo, cloth boards, 6s. per Volume.

Fletcher's (Giles, B.D.) Complete Poems. One Vol.

Davies' (Sir John) Complete Poetical Works. Two Vols.

Herrick's (Robert) Complete Collected Poems. Three Vols.

Sidney's (Sir Philip) Complete Poetical Works. Three Vols.

Herbert (Lord) of Cherbury's Poems. Edited, with Introduction, by J. CHURTON COLLINS. Crown 8vo, parchment, 8s.

**Emanuel. — On Diamonds and Precious Stones;** their History, Value, and Properties; with Simple Tests for ascertaining their Reality. By HARRY EMANUEL, F.R.G.S. With numerous Illustrations, tinted and plain. Crown 8vo, cloth extra, gilt, 6s.

**Englishman's House, The: A Practical Guide** to all interested in Selecting or Building a House, with full Estimates of Cost, Quantities, &c. By C. J. RICHARDSON. Third Edition. With nearly 600 Illustrations. Crown 8vo, cloth extra, 7s. 6d.

**Ewald (Alex. Charles, F.S.A.), Works by :**

Stories from the State Papers. With an Autotype Facsimile. Crown 8vo, cloth extra, 6s.

The Life and Times of Prince Charles Stuart, Count of Albany, commonly called the Young Pretender. From the State Papers and other Sources. New and Cheaper Edition, with a Portrait, crown 8vo, cloth extra, 7s. 6d.

**Eyes, The. — How to Use our Eyes, and How to Preserve Them.** By JOHN BROWNING, F.R.A.S., &c. With 37 Illustrations. Crown 8vo, 1s.; cloth 1s. 6d.

**Fairholt. — Tobacco: Its History and Associations;** with an Account of the Plant and its Manufacture, and its Modes of Use in all Ages and Countries. By F. W. FAIRHOLT, F.S.A. With Coloured Frontispiece and upwards of 100 Illustrations by the Author. Crown 8vo, cloth extra, 6s.

**Familiar Allusions:** A Handbook of Miscellaneous Information; including the Names of Celebrated Statues, Paintings, Palaces, Country Seats, Ruins, Churches, Ships, Streets, Clubs, Natural Curiosities, and the like. By WILLIAM A. WHEELER, Author of "Noted Names of Fiction;" and CHARLES G. WHEELER. Demy 8vo, cloth extra, 7s. 6d.

**Faraday (Michael), Works by:**  
**The Chemical History of a Candle:** Lectures delivered before a Juvenile Audience at the Royal Institution. Edited by WILLIAM CROOKES, F.C.S. Post 8vo, cloth extra, with numerous Illustrations, 4s. 6d.

**On the Various Forces of Nature,** and their Relations to each other: Lectures delivered before a Juvenile Audience at the Royal Institution. Edited by WILLIAM CROOKES, F.C.S. Post 8vo, cloth extra, with numerous Illustrations, 4s. 6d.

**Fin-Bec.—The Cupboard Papers:** Observations on the Art of Living and Dining. By FIN-BEC. Post 8vo, cloth limp, 2s. 6d.

**Fitzgerald (Percy), Works by:**  
**The Recreations of a Literary Man;** or, Does Writing Pay? With Recollections of some Literary Men, and a View of a Literary Man's Working Life. Cr. 8vo, cloth extra, 6s.

**The World Behind the Scenes.** Crown 8vo, cloth extra, 3s. 6d.

**Little Essays:** Passages from the Letters of CHARLES LAMB. Post 8vo, cloth limp, 2s. 6d.

Post 8vo, illustrated boards, 2s. each.  
**Bella Donna.** | **Never Forgotten.**  
**The Second Mrs. Tillotson.**  
**Polly.**  
Seventy-five Brooke Street.

**Fletcher's (Giles, B.D.) Complete Poems:** Christ's Victorie in Heaven, Christ's Victorie on Earth, Christ's Triumph over Death, and Minor Poems. With Memorial-Introduction and Notes by the Rev. A. B. GROSART, D.D. Cr. 8vo, cloth bds., 6s.

**Fonblanque.—Filthy Lucre:** A Novel. By ALBANY DE FONBLANQUE. Post 8vo, illustrated boards, 2s.

**French Literature, History of.** By HENRY VAN LAUN. Complete in 3 Vols., demy 8vo, cl. bds., 7s. 6d. each.

**Francillon (R. E.), Novels by:**  
Crown 8vo, cloth extra, 3s. 6d. each;  
post 8vo, illust. boards, 2s. each.  
**Olympia.** | **Queen Cophetua.**  
**One by One.**

**Esther's Glove.** Fcap. 8vo, picture cover, 1s.

**A Real Queen.** Three Vols., cr. 8vo.

**Frere.—Pandurang Hari;** or, Memoirs of a Hindoo. With a Preface by Sir H. BARTLE FRERE, G.C.S.I., &c. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Friswell.—One of Two:** A Novel. By HAIN FRISWELL. Post 8vo, illustrated boards, 2s.

**Frost (Thomas), Works by:**  
Crown 8vo, cloth extra, 3s. 6d. each.  
**Circus Life and Circus Celebrities.**  
**The Lives of the Conjurors.**  
**The Old Showmen and the Old London Fairs.**

**Fry.—Royal Guide to the London Charities, 1884-5.** By HERBERT FRY. Showing, in alphabetical order, their Name, Date of Foundation, Address, Objects, Annual Income, Chief Officials, &c. Published Annually. Crown 8vo, cloth, 1s. 6d. [Immediately.]

#### Gardening Books:

**A Year's Work in Garden and Greenhouse:** Practical Advice to Amateur Gardeners as to the Management of the Flower, Fruit, and Frame Garden. By GEORGE GLENNY. Post 8vo, cloth limp, 2s. 6d.

**Our Kitchen Garden:** The Plants we Grow, and How we Cook Them. By TOM JERROLD, Author of "The Garden that Paid the Rent," &c. Post 8vo, cloth limp, 2s. 6d.

**Household Horticulture:** A Gossip about Flowers. By TOM and JANE JERROLD. Illustrated. Post 8vo, cloth limp, 2s. 6d.

**The Garden that Paid the Rent.** By TOM JERROLD. Fcap. 8vo, illustrated cover, 1s.; cloth limp, 1s. 6d.

**Garrett.—The Capel Girls:** A Novel. By EDWARD GARRETT. Post 8vo, illust. bds., 2s.; cr. 8vo, cl. ex., 3s. 6d.

**German Popular Stories.** Collected by the Brothers GRIMM, and Translated by EDGAR TAYLOR. Edited, with an Introduction, by JOHN RUSKIN. With 22 Illustrations on Steel by GEORGE CRUESHANK. Square 8vo, cloth extra, 6s. 6d. gilt edges, 7s. 6d.

## BOOKS PUBLISHED BY

**Gentleman's Magazine (The)** for 1884. One Shilling Monthly. A New Serial Story, entitled "Phyllis," by CECIL POWER, is now appearing. "Science Notes," by W. MATTIEU WILLIAMS, F.R.A.S., and "Table Talk," by SYLVANUS URBAN, are also continued monthly.

\* \* \* Now ready, the Volume for JULY to DECEMBER, 1883, cloth extra, price 8s. 6d.; Cases for binding, 2s. each.

**Gibbon (Charles), Novels by :**

Crown 8vo, cloth extra, 3s. 6d. each;  
post 8vo, illustrated boards, 2s. each.  
Robin Gray.

For Lack of Gold.  
What will the World Say?  
In Honour Bound.  
In Love and War.  
For the King.  
Queen of the Meadow.  
In Pastures Green.  
The Braes of Yarrow.  
The Flower of the Forest.  
A Heart's Problem.

Post 8vo, illustrated boards, 2s.  
The Dead Heart.

Crown 8vo, cloth extra, 2s. 6d. each.

The Golden Shaft.  
Of High Degree.

Fancy-Free. Three Vols., crown 8vo.

**Gilbert (William), Novels by :**

Post 8vo, illustrated boards, 2s. each.

Dr. Austin's Guests.  
The Wizard of the Mountain.  
James Duke, Costermonger.

**Gilbert (W. S.), Original Plays** by: In Two Series, each complete in itself, price 2s. 6d. each.

The FIRST SERIES contains—The Wicked World—Pygmalion and Galatea—Charity—The Princess—The Palace of Truth—Trial by jury.

The SECOND SERIES contains—Broken Hearts—Engaged—Sweethearts—Gretchen—Dan'l Druce—Tom Cobb—H.M.S. Pinafore—The Sorcerer—The Pirates of Penzance.

**Glenny.—A Year's Work in**

Garden and Greenhouse: Practical Advice to Amateur Gardeners as to the Management of the Flower, Fruit, and Frame Garden. By GEORGE GLENNY. Post 8vo, cloth limp, 2s. 6d.

**Godwin.—Lives of the Necromancers.** By WILLIAM GODWIN. Post 8vo, cloth limp, 2s.

**Golden Library, The :**

Square 16mo (Tauchnitz size), cloth limp, 2s. per volume.

Bayard Taylor's Diversions of the Echo Club.

Bennett's (Dr. W. C.) Ballad History of England.

Bennett's (Dr. W. C.) Songs for Sailors.

Byron's Don Juan.

Godwin's (William) Lives of the Necromancers.

Holmes's Autocrat of the Breakfast Table. With an Introduction by G. A. SALA.

Holmes's Professor at the Breakfast Table.

Hood's Whims and Oddities. Complete. All the original illustrations.

Irving's (Washington) Tales of a Traveller.

Irving's (Washington) Tales of the Alhambra.

Jesse's (Edward) Scenes and Occupations of a Country Life.

Lamb's Essays of Elia. Both Series Complete in One Vol.

Leigh Hunt's Essays: A Tale for a Chimney Corner, and other Pieces. With Portrait, and Introduction by EDMUND OLLIER.

Mallory's (Sir Thomas) Mort d'Arthur: The Stories of King Arthur and of the Knights of the Round Table. Edited by B. MONTGOMERIE RANKING.

Pascal's Provincial Letters. A New Translation, with Historical Introduction and Notes, by T. M'CRIE, D.D.

Pope's Poetical Works. Complete.

Roche-foucauld's Maxims and Moral Reflections. With Notes, and Introductory Essay by SAINT-BEUVE.

St. Pierre's Paul and Virginia, and The Indian Cottage. Edited, with Life, by the Rev. E. CLARKE.

Shelley's Early Poems, and Queen Mab. With Essay by LEIGH HUNT.

Shelley's Later Poems: Laon and Cythna, &c.

Shelley's Posthumous Poems, the Shelley Papers, &c.

Shelley's Prose Works, including A Refutation of Deism, Zastrozzi, St. Irvyne, &c.

White's Natural History of Selborne. Edited, with Additions, by THOMAS BROWN, F.L.S.

**Golden Treasury of Thought,**  
The: AN ENCYCLOPÆDIA OF QUOTATIONS from Writers of all Times and Countries. Selected and Edited by THEODORE TAYLOR. Crown 8vo, cloth gilt and gilt edges, 7s. 6d.

**Gordon Cumming (C. F.), Works by:**

In the *Hebrides*. With Autotype Facsimile and numerous full-page Illustrations. Demy 8vo, cloth extra, 8s. 6d.

In the *Himalayas*. With numerous Illustrations. Demy 8vo, cloth extra, 8s. 6d. [Shortly.]

**Graham. — The Professor's Wife:** A Story. By LEONARD GRAHAM. Fcap. 8vo, picture cover, 1s.; cloth extra, 2s. 6d.

**Greeks and Romans, The Life of the,** Described from Antique Monuments. By ERNST GUHL and W. KONER. Translated from the Third German Edition, and Edited by Dr. F. HUEFFER. With 545 Illustrations. New and Cheaper Edition, demy 8vo, cloth extra, 7s. 6d.

**Greenwood (James), Works by:**

*The Wilds of London*. Crown 8vo, cloth extra, 3s. 6d.

*Low-Life Deeps:* An Account of the Strange Fish to be Found There. Crown 8vo, cloth extra, 3s. 6d.

*Dick Temple:* A Novel. Post 8vo, illustrated boards, 2s.

**Guyot. — The Earth and Man;** or, Physical Geography in its relation to the History of Mankind. By ARNOLD GUYOT. With Additions by Professors AGASSIZ, PIERCE, and GRAY; 12 Maps and Engravings on Steel, some Coloured, and copious Index. Crown 8vo, cloth extra, gilt, 4s. 6d.

**Hair (The): Its Treatment in Health, Weakness, and Disease.** Translated from the German of Dr. J. PINCUS. Crown 8vo, 1s.; cloth, 1s. 6d.

**Hake (Dr. Thomas Gordon), Poems by:**

*Malden Ecstasy*. Small 4to, cloth extra, 8s.

*New Symbols*. Crown 8vo, cloth extra, 6s.

*Legends of the Morrow*. Crown 8vo, cloth extra, 6s.

*The Serpent Play*. Crown 8vo, cloth extra, 6s.

**Hall. — Sketches of Irish Character.** By Mrs. S. C. HALL. With numerous Illustrations on Steel and Wood by MACLISE, GILBERT, HARVEY, and G. CRUIKSHANK. Medium 8vo, cloth extra, gilt, 7s. 6d.

**Halliday. — Every-day Papers.** By ANDREW HALLIDAY. Post 8vo, illustrated boards, 2s.

**Handwriting, The Philosophy of.** With over 100 Facsimiles and Explanatory Text. By DON FELIX DE SALAMANCA. Post 8vo, cloth limp, 2s. 6d.

**Hanky-Panky:** A Collection of Very Easy Tricks, Very Difficult Tricks, White Magic, Sleight of Hand, &c. Edited by W. H. CREMER. With 200 Illustrations. Crown 8vo, cloth extra, 4s. 6d.

**Hardy (Lady Duffus). — Paul Wynter's Sacrifice:** A Story. By Lady DUFFUS HARDY. Post 8vo, illust. boards, 2s.

**Hardy (Thomas). — Under the Greenwood Tree.** By THOMAS HARDY, Author of "Far from the Madding Crowd." Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Haweis (Mrs. H. R.), Works by:**

*The Art of Dress*. With numerous Illustrations. Small 8vo, illustrated cover, 1s.; cloth limp, 1s. 6d.

*The Art of Beauty*. New and Cheaper Edition. Crown 8vo, cloth extra, with Coloured Frontispiece and Illustrations, 6s.

*The Art of Decoration*. Square 8vo, handsomely bound and profusely illustrated, 10s. 6d.

*Chaucer for Children:* A Golden Key. With Eight Coloured Pictures and numerous Woodcuts. New Edition, small 4to, cloth extra, 6s.

*Chaucer for Schools*. Demy 8vo, cloth limp, 2s. 6d.

**Haweis (Rev. H. R.). — American Humorists.** Including WASHINGTON IRVING, OLIVER WENDELL HOLMES, JAMES RUSSELL LOWELL, ARTEMUS WARD, MARK TWAIN, and BRET HARTE. By the Rev. H. R. HAWEIS, M.A. Crown 8vo, cloth extra, 6s.

**Hawthorne (Julian), Novels by.**  
Crown 8vo, cloth extra, 3s. 6d. each;  
post 8vo, illustrated boards, 2s. each.

Garth.

Ellice Quentin.

Sebastian Strome.

Prince Saroni's Wife.

Dust.

**Mrs. Gainsborough's Diamonds.**  
Fcap. 8vo, illustrated cover, 1s.;  
cloth extra, 2s. 6d.

**Fortune's Fool.** Crown 8vo, cloth  
extra, 3s. 6d.

**Beatrice Randolph.** With Illustrations  
by A. FREDERICKS. Crown 8vo, cloth  
extra, 3s. 6d. [*Preparing.*]

**Heath (F. G.). — My Garden**  
Wild, and What I Grew There. By  
FRANCIS GEORGE HEATH, Author of  
"The Fern World," &c. Crown 8vo,  
cloth extra, 5s.; cloth gilt, and gilt  
edges, 6s.

**Helps (Sir Arthur), Works by :**  
**Animals and their Masters.** Post  
8vo, cloth limp, 2s. 6d.

**Social Pressure.** Post 8vo, cloth limp,  
2s. 6d.

**Ivan de Biron: A Novel.** Crown 8vo,  
cloth extra, 3s. 6d.; post 8vo, illus-  
trated boards, 2s.

**Heptalogia (The); or, The**  
Seven against Sense. A Cap with  
Seven Bells. Cr. 8vo, cloth extra, 6s.

**Herbert. — The Poems of Lord**  
Herbert of Cherbury. Edited, with  
an Introduction, by J. CHURTON  
COLLINS. Crown 8vo, bound in parch-  
ment, 8s.

**Herrick's (Robert) Hesperides,**  
Noble Numbers, and Complete Col-  
lected Poems. With Memorial-Intro-  
duction and Notes by the Rev. A. B.  
GROSART, D.D. Steel Portrait, Index  
of First Lines, and Glossarial Index,  
&c. Three Vols., crown 8vo, cloth  
boards, 18s.

**Hesse-Wartegg (Chevalier**  
Ernst von), Works by :

**Tunis: The Land and the People.**  
With 22 Illustrations. Crown 8vo,  
cloth extra, 3s. 6d.

**The New South-West: Travelling**  
Sketches from Kansas, New Mexico,  
Arizona, and Northern Mexico.  
With 100 fine Illustrations and Three  
Maps. Demy 8vo, cloth extra,  
14s. [*In preparation.*]

**Hindley (Charles), Works by :**  
Crown 8vo, cloth extra, 3s. 6d. each.

**Tavern Anecdotes and Sayings:** In-  
cluding the Origin of Signs, and  
Reminiscences connected with  
Taverns, Coffee Houses, Clubs, &c.  
With Illustrations.

**The Life and Adventures of a Cheap**  
Jack. By One of the Fraternity.  
Edited by CHARLES HINDLEY.

**Holmes (O. Wendell), Works by :**

**The Autocrat of the Breakfast-**  
Table. Illustrated by J. GORDON  
THOMSON. Post 8vo, cloth limp,  
2s. 6d.; another Edition in smaller  
type, with an Introduction by G. A.  
SALA. Post 8vo, cloth limp, 2s.

**The Professor at the Breakfast-**  
Table; with the Story of Iris. Post  
8vo, cloth limp, 2s.

**Holmes. — The Science of**  
Voice Production and Voice Preser-  
vation: A Popular Manual for the  
Use of Speakers and Singers. By  
GORDON HOLMES, M.D. Crown 8vo,  
cloth limp, with Illustrations, 2s. 6d.

**Hood (Thomas):**

**Hood's Choice Works, in Prose and**  
Verse. Including the Cream of the  
Comic Annuals. With Life of the  
Author, Portrait, and 200 Illus-  
trations. Crown 8vo, cloth extra, 7s. 6d.

**Hood's Whims and Oddities.** Com-  
plete. With all the original Illus-  
trations. Post 8vo, cloth limp, 2s.

**Hood (Tom), Works by :**

**From Nowhere to the North Pole**  
A Noah's Arkæological Narrative.  
With 25 Illustrations by W. BRUN-  
TON and E. C. BARNES. Square  
crown 8vo, cloth extra, gilt edges, 6s.

**A Golden Heart: A Novel.** Post 8vo,  
illustrated boards, 2s.

**Hook's (Theodore) Choice Hu-**  
morous Works, including his Ludi-  
cious Adventures, Bons Mots, Puns and  
Hoaxes. With a New Life of the  
Author, Portraits, Facsimiles, and  
Illustrations. Crown 8vo, cloth extra,  
gilt, 7s. 6d.

**Hooper. — The House of Raby :**  
A Novel. By Mrs. GEORGE HOOPER.  
Post 8vo, illustrated boards, 2s.

**Horne. — Orion: An Epic Poem,**  
in Three Books. By RICHARD HEN-  
RIST HORNE. With Photographic  
Portrait from a Medallion by SUM-  
MERS. Tenth Edition, crown 8vo,  
cloth extra, 7s.

**Howell.—Conflicts of Capital and Labour.** Historically and Economically considered: Being a History and Review of the Trade Unions of Great Britain, showing their Origin, Progress, Constitution, and Objects, in their Political, Social, Economical, and Industrial Aspects. By GEORGE HOWELL. Cr. 8vo, cloth extra, 7s. 6d.

**Hugo.—The Hunchback of Notre Dame.** By VICTOR HUGO. Post 8vo, illustrated boards, 2s.

**Hunt.—Essays by Leigh Hunt.** A Tale for a Chimney Corner, and other Pieces. With Portrait and Introduction by EDMUND OLLIER. Post 8vo, cloth limp, 2s.

**Hunt (Mrs. Alfred), Novels by:**  
Crown 8vo, cloth extra, 3s. 6d. each;  
post 8vo, illustrated boards, 2s. each.  
*Thornicroft's Model.*  
*The Leadon Casket.*  
*Self-Condemned.*

**Ingelow.—Fated to be Free: A Novel.** By JEAN INGELow. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Irish Wit and Humour, Songs of.** Collected and Edited by A. PERCEVAL GRAVES. Post 8vo, cloth limp, 2s. 6d.

**Irving (Henry).—The Paradox of Acting.** Translated, with Annotations, from Diderot's "Le Paradoxe sur le Comédien," by WALTER HERRIES POLLOCK. With a Preface by HENRY IRVING. Crown 8vo, in parchment, 4s. 6d.

**Irving (Washington), Works by:**  
Post 8vo, cloth limp, 2s. each.  
*Tales of a Traveller.*  
*Tales of the Alhambra.*

**James.—Confidence: A Novel.** By HENRY JAMES, Jun. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Janvier.—Practical Ceramics for Students.** By CATHERINE A. JANVIER. Crown 8vo, cloth extra, 6s.

**Jay (Harriett), Novels by.** Each crown 8vo, cloth extra, 3s. 6d.; or post 8vo, illustrated boards, 2s.  
*The Dark Colleen.*  
*The Queen of Connaught.*

**Jefferies (Richard), Works by:**  
*Nature near London.* Crown 8vo, cloth extra, 6s.  
*The Life of the Fields.* Crown 8vo, cloth extra, 6s. [*In the press.*]

**Jennings (H. J.).—Curiosities of Criticism.** By HENRY J. JENNINGS. Post 8vo, cloth limp, 2s. 6d.

**Jennings (Hargrave).—The Rosicrucians: Their Rites and Mysteries.** With Chapters on the Ancient Fire and Serpent Worshipers. By HARGRAVE JENNINGS. With Five full-page Plates and upwards of 300 Illustrations. A New Edition, crown 8vo, cloth extra, 7s. 6d.

**Jerrold (Tom), Works by:**  
*The Garden that Paid the Rent* By TOM JERROLD. Fcap. 8vo, illustrated cover, 1s.; cloth limp, 1s. 6d.  
*Household Horticulture: A Gossip about Flowers.* By TOM and JANE JERROLD. Illustrated. Post 8vo, cloth limp, 2s. 6d.

*Our Kitchen Garden: The Plants we Grow, and How we Cook Them.* By TOM JERROLD. Post 8vo, cloth limp, 2s. 6d.

**Jesse.—Scenes and Occupations of a Country Life.** By EDWARD JESSE. Post 8vo, cloth limp, 2s.

**Jones (Wm., F.S.A.), Works by:**  
*Finger-Ring Lore: Historical, Legendary, and Anecdotal.* With over 200 Illustrations. Crown 8vo, cloth extra, 7s. 6d.

*Credulities, Past and Present; including the Sea and Seamen, Miners, Talismans, Word and Letter Divination, Exorcising and Blessing of Animals, Birds, Eggs, Luck, &c.* With an Etched Frontispiece. Crown 8vo, cloth extra, 7s. 6d.

*Crowns and Coronations: A History of Regalia in all Times and Countries. With One Hundred Illustrations.* Cr. 8vo, cloth extra, 7s. 6d.

**Jonson's (Ben) Works.** With Notes Critical and Explanatory, and a Biographical Memoir by WILLIAM GIFFORD. Edited by Colonel CUNNINGHAM. Three Vols., crown 8vo, cloth extra, 18s.; or separately, 6s. each.

**Josephus, The Complete Works of.** Translated by WHISTON. Containing both "The Antiquities of the Jews" and "The Wars of the Jews." Two Vols., 8vo, with 52 Illustrations and Maps, cloth extra, gilt, 14s.

## BOOKS PUBLISHED BY

**Kavanagh.—The Pearl Fountain, and other Fairy Stories.** By BRIDGET and JULIA KAVANAGH. With Thirty Illustrations by J. MOYR SMITH. Small 8vo, cloth gilt, 6s.

**Kempton.—Pencil and Palette:** Chapters on Art and Artists. By ROBERT KEMPT. Post 8vo, cloth limp, 2s. 6d.

**Kingsley (Henry), Novels by:** Each crown 8vo, cloth extra, 3s. 6d.; or post 8vo, illustrated boards, 2s.

**Oakshott Castle. | Number Seventeen**

**Lamb (Charles):**

**Mary and Charles Lamb:** Their Poems, Letters, and Remains. With Reminiscences and Notes by W. CAREW HAZLITT. With HARCOCK'S Portrait of the Essayist, Facsimiles of the Title-pages of the rare First Editions of Lamb's and Coleridge's Works, and numerous Illustrations. Crown 8vo, cloth extra, 10s. 6d.

**Lamb's Complete Works, in Prose and Verse,** reprinted from the Original Editions, with many Pieces hitherto unpublished. Edited, with Notes and Introduction, by R. H. SHEPHERD. With Two Portraits and Facsimile of Page of the "Essay on Roast Pig." Cr. 8vo, cloth extra, 7s. 6d.

**The Essays of Elia.** Complete Edition. Post 8vo, cloth extra, 2s.

**Poetry for Children, and Prince Dorus.** By CHARLES LAMB. Carefully Reprinted from unique copies. Small 8vo, cloth extra, 5s.

**Little Essays: Sketches and Characters.** By CHARLES LAMB. Selected from his Letters by PERCY FITZGERALD. Post 8vo, cloth limp, 2s. 6d.

**Lane's Arabian Nights, &c.:**

**The Thousand and One Nights:** commonly called, in England, "The Arabian Nights' ENTERTAINMENTS." A New Translation from the Arabic, with copious Notes, by EDWARD WILLIAM LANE. Illustrated by many hundred Engravings on Wood, from Original Designs by WM. HARVEY. A New Edition, from a Copy annotated by the Translator, edited by his Nephew, EDWARD STANLEY POOLE. With a Preface by STANLEY LANE-POOLE. Three Vols., demy 8vo, cloth extra, 7s. 6d. each.

**Arabian Society in the Middle Ages:** Studies from "The Thousand and One Nights." By EDWARD WILLIAM LANE, Author of "The Modern Egyptians," &c. Edited by STANLEY LANE-POOLE. Cr. 8vo, cloth extra, 6s.

**Lares and Penates; or, The Background of Life.** By FLORENCE CADDY. Crown 8vo, cloth extra, 6s.

**Larwood (Jacob), Works by:**

**The Story of the London Parks.** With Illustrations. Crown 8vo, cloth extra, 3s. 6d.

**Clerical Anecdotes.** Post 8vo, cloth limp, 2s. 6d.

**Forensic Anecdotes.** Post 8vo, cloth limp, 2s. 6d.

**Theatrical Anecdotes.** Post 8vo, cloth limp, 2s. 6d.

**Leigh (Henry S.), Works by:**

**Carols of Cockayne.** With numerous Illustrations. Post 8vo, cloth limp, 2s. 6d.

**Jeux d'Esprit.** Collected and Edited by HENRY S. LEIGH. Post 8vo, cloth limp, 2s. 6d.

**Life in London; or, The History of Jerry Hawthorn and Corinthian Tom.** With the whole of CRUIKSHANK'S Illustrations, in Colours, after the Originals. Crown 8vo, cloth extra, 7s. 6d.

**Linton (E. Lynn), Works by:**

Post 8vo, cloth limp, 2s. 6d. each.

**Witch Stories.**

**The True Story of Joshua Davidson.**

**Ourselves** Essays on Women.

Crown 8vo, cloth extra, 3s. 6d. each; post 8vo, illustrated boards, 2s. each.

**Patricia Kemball.**

**The Atonement of Leam Dundas.**

**The World Well Lost.**

**Under which Lord?**

**With a Silken Thread.**

**The Rebel of the Family.**

**"My Love!"**

**Ione.** Three Vols., crown 8vo.

**Locks and Keys.—On the Development and Distribution of Primitive Locks and Keys.** By Lieut.-Gen. PITT-RIVERS, F.R.S. With numerous Illustrations. Demy 4to, half Roanburghe, 16s.

**Longfellow :**

**Longfellow's Complete Prose Works.** Including "Outre Mer," "Hyperion," "Kavanagh," "The Poets and Poetry of Europe," and "Driftwood." With Portrait and Illustrations by VALENTINE BROMLEY. Crown 8vo, cloth extra, 7s. 6d.

**Longfellow's Poetical Works.** Carefully Reprinted from the Original Editions. With numerous fine Illustrations on Steel and Wood. Crown 8vo, cloth extra, 7s. 6d.

**Lucy.—Gideon Fleyce: A Novel.** By HENRY W. LUCY. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Lusiad (The) of Camoens.** Translated into English Spenserian Verse by ROBERT FRENCH DUFF. Demy 8vo, with Fourteen full-page Plates, cloth boards, 18s.

**McCarthy (Justin, M.P.), Works by :**

**A History of Our Own Times,** from the Accession of Queen Victoria to the General Election of 1880. Four Vols. demy 8vo, cloth extra, 12s. each.—Also a POPULAR EDITION, in Four Vols. crown 8vo, cloth extra, 6s. each.

**A Short History of Our Own Times.** One Volume, crown 8vo, cloth extra, 6s.

**History of the Four Georges.** Four Vols. demy 8vo, cloth extra, 12s. each. [Vol. I. in the press.

Crown 8vo, cloth extra, 3s. 6d. each; post 8vo, illustrated boards, 2s. each.

Dear Lady Disdain.

The Waterdale Neighbours.

My Enemy's Daughter.

A Fair Saxon.

Linley Rochford

Miss Misanthrope.

Donna Quixote.

The Comet of a Season.

**Maid of Athens.** With 12 Illustrations by F. BARNARD. Three Vols., crown 8vo.

**McCarthy (Justin H.), Works by :**

**Serapion, and other Poems.** Crown 8vo, cloth extra, 6s.

**An Outline of the History of Ireland,** from the Earliest Times to the Present Day. Cr. 8vo, 1s.; cloth, 1s. 6d.

**MacDonald (George, LL.D.),**

**Works by :**

**The Princess and Curdie.** With 11 Illustrations by JAMES ALLEN. Small crown 8vo, cloth extra, 5s.

**Gutta-Percha Willie, the Working Genius.** With 9 Illustrations by ARTHUR HUGHES. Square 8vo, cloth extra, 3s. 6d.

**Paul Faber, Surgeon.** With a Frontispiece by J. E. MILLAIS. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Thomas Wingfold, Curate.** With a Frontispiece by C. J. STANILAND. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Macdonell.—Quaker Cousins:**

**A Novel.** By AGNES MACDONELL. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Macgregor. — Pastimes and Players.** Notes on Popular Games. By ROBERT MACGREGOR. Post 8vo, cloth limp, 2s. 6d.

**MacIse Portrait-Gallery (The)**

**of Illustrious Literary Characters;** with Memoirs—Biographical, Critical, Bibliographical, and Anecdotal—illustrative of the Literature of the former half of the Present Century. By WILLIAM BATES, B.A. With 85 Portraits printed on an India Tint. Crown 8vo, cloth extra, 7s. 6d.

**Macquoid (Mrs.), Works by :**

**In the Ardennes.** With 50 fine Illustrations by THOMAS R. MACQUOID. Square 8vo, cloth extra, 10s. 6d.

**Pictures and Legends from Normandy and Brittany.** With numerous Illustrations by THOMAS R. MACQUOID. Square 8vo, cloth gilt, 10s. 6d.

**Through Normandy.** With 50 Illustrations by T. R. MACQUOID. Square 8vo, cloth extra, 7s. 6d.

**Through Brittany.** With numerous Illustrations by T. R. MACQUOID. Square 8vo, cloth extra, 7s. 6d.

**About Yorkshire.** With 67 Illustrations by T. R. MACQUOID. Engraved by SWAIN. Square 8vo, cloth extra, 10s. 6d.

**The Evil Eye, and other Stories.** Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Lost Rose, and other Stories.** Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Mackay.—Interludes and Undertones:** or, Music at Twilight. By CHARLES MACKAY, LL.D. Crown 8vo, cloth extra, 6s.

**Magician's Own Book (The):** Performances with Cups and Balls, Eggs, Hats, Handkerchiefs, &c. All from actual Experience. Edited by W. H. CREMER. With 200 Illustrations. Crown 8vo, cloth extra, 4s. 6d.

**Magic No Mystery:** Tricks with Cards, Dice, Balls, &c., with fully descriptive Directions; the Art of Secret Writing; Training of Performing Animals, &c. With Coloured Frontispiece and many Illustrations. Crown 8vo, cloth extra, 4s. 6d.

**Magna Charta.** An exact Facsimile of the Original in the British Museum, printed on fine plate paper, 3 feet by 2 feet, with Arms and Seals emblazoned in Gold and Colours. Price 5s.

**Mallock (W. H.), Works by:**

**The New Republic;** or, Culture, Faith and Philosophy in an English Country House. Post 8vo, cloth limp, 2s. 6d.; Cheap Edition, illustrated boards, 2s.

**The New Paul and Virginia;** or, Positivism on an Island. Post 8vo, cloth limp, 2s. 6d.

**Poems.** Small 4to, bound in parchment, 8s.

**Is Life worth Living?** Crown 8vo, cloth extra, 6s.

**Mallory's (Sir Thomas) Mort d'Arthur:** The Stories of King Arthur and of the Knights of the Round Table. Edited by B. MONTGOMERIE RANKING. Post 8vo, cloth limp, 2s.

**Marlowe's Works.** Including his Translations. Edited, with Notes and Introduction, by Col. CUNNINGHAM. Crown 8vo, cloth extra, 6s.

**Marryat (Florence), Novels by:** Crown 8vo, cloth extra, 3s. 6d. each; or, post 8vo, illustrated boards, 2s.

**Open! Sesame!**

**Written in Fire.**

Post 8vo, illustrated boards, 2s. each.

**A Harvest of Wild Oats.**

**A Little Stepson.**

**Fighting the Air.**

**Masterman.—Half a Dozen Daughters:** A Novel. By J. MASTERMAN. Post 8vo, illustrated boards, 2s.

**Mark Twain, Works by:**

**The Choice Works of Mark Twain.** Revised and Corrected throughout by the Author. With Life, Portrait, and numerous Illustrations. Crown 8vo, cloth extra, 7s. 6d.

**The Adventures of Tom Sawyer.** With 100 Illustrations. Small 8vo, cloth extra, 7s. 6d. CHEAP EDITION, illustrated boards, 2s.

**An Idle Excursion,** and other Sketches. Post 8vo, illustrated boards, 2s.

**The Prince and the Pauper.** With nearly 200 Illustrations. Crown 8vo, cloth extra, 7s. 6d.

**The Innocents Abroad;** or, The New Pilgrim's Progress: Being some Account of the Steamship "Quaker City's" Pleasure Excursion to Europe and the Holy Land. With 234 Illustrations. Crown 8vo, cloth extra, 7s. 6d. CHEAP EDITION (under the title of "MARK TWAIN'S PLEASURE TRIP"), post 8vo, illust. boards, 2s.

**A Tramp Abroad.** With 314 Illustrations. Crown 8vo, cloth extra, 7s. 6d. Without Illustrations, post 8vo, illustrated boards, 2s.

**The Stolen White Elephant,** &c. Crown 8vo, cloth extra, 6s.; post 8vo, illustrated boards, 2s.

**Life on the Mississippi.** With about 300 Original Illustrations. Crown 8vo, cloth extra, 7s. 6d.

**The Adventures of Huckleberry Finn.** With numerous Illustrations by the Author. Crown 8vo, cloth extra, 7s. 6d. [Preparing.]

**Massinger's Plays.** From the Text of WILLIAM GIFFORD. Edited by Col. CUNNINGHAM. Crown 8vo, cloth extra, 6s.

**Mayhew.—London Characters and the Humorous Side of London Life.** By HENRY MAYHEW. With numerous Illustrations. Crown 8vo, cloth extra, 3s. 6d.

**Mayfair Library, The:**

Post 8vo, cloth limp, 2s. 6d. per Volume.

**A Journey Round My Room.** By XAVIER DE MAISTRE. Translated by HENRY ATTWELL.

**Latter-Day Lyrics.** Edited by W. DAVENPORT ADAMS.

**Quips and Quiddities.** Selected by W. DAVENPORT ADAMS.

**The Agony Column of "The Times,"** from 1800 to 1870. Edited, with an Introduction, by ALICE CLAY.

**Balzac's "Comedie Humaine"** and its Author. With Translations by H. H. WALKER.

MAYFAIR LIBRARY, *continued*—

**Melancholy Anatomised:** A Popular Abridgment of "Burton's Anatomy of Melancholy."

**Gastronomy as a Fine Art.** By BRILLAT-SAVARIN.

**The Speeches of Charles Dickens.** Literary Frivolities, Fancies, Follies, and Frolics. By W. T. DOBSON.

**Poetical Ingeniuties and Eccentricities.** Selected and Edited by W. T. DOBSON.

**The Cupboard Papers.** By FIN-BEC.

**Original Plays** by W. S. GILBERT. FIRST SERIES. Containing: The Wicked World—Pygmalion and Galatea—Charity—The Princess—The Palace of Truth—Trial by Jury.

**Original Plays** by W. S. GILBERT. SECOND SERIES. Containing: Broken Hearts—Engaged—Sweethearts—Gretchen—Dan'l Druce—Tom Cobb—H.M.S. Pinafore—The Sorcerer—The Pirates of Penzance.

**Songs of Irish Wit and Humour.** Collected and Edited by A. PERCEVAL GRAYES.

**Animals and their Masters.** By SIR ARTHUR HELPS.

**Social Pressure.** By SIR A. HELPS.

**Curiosities of Criticism.** By HENRY J. JENNINGS.

**The Autocrat of the Breakfast-Table.** By OLIVER WENDELL HOLMES. Illustrated by J. GORDON THOMSON.

**Pencil and Palette.** By ROBERT KEMPT.

**Little Essays:** Sketches and Characters. By CHARLES LAMB. Selected from his Letters by PERCY FITZGERALD.

**Clerical Anecdotes.** By JACOB LARWOOD.

**Forensic Anecdotes;** or, Humour and Curiosities of the Law and Men of Law. By JACOB LARWOOD.

**Theatrical Anecdotes.** By JACOB LARWOOD.

**Carols of Cockayne.** By HENRY S. LEIGH.

**Jeux d'Esprit.** Edited by HENRY S. LEIGH.

**True History of Joshua Davidson.** By E. LYNN LINTON.

**Witch Stories.** By E. LYNN LINTON.

**Ourselves:** Essays on Women. By E. LYNN LINTON.

**Pastimes and Players.** By ROBERT MACGREGOR.

**The New Paul and Virginia.** By W. H. MALLOCH.

MAYFAIR LIBRARY, *continued*—

**The New Republic.** By W. H. MALLOCH.

**Puck on Pegasus.** By H. CHOLMONDELEY-PENNELLS.

**Pegasus Re-Saddled.** By H. CHOLMONDELEY-PENNELLS. Illustrated by GEORGE DU MAURIER.

**Muses of Mayfair.** Edited by H. CHOLMONDELEY-PENNELLS.

**Thoreau: H's Life and Aims.** By H. A. PAGE.

**Puniana.** By the Hon. HUGH ROWLEY.

**More Puniana.** By the Hon. HUGH ROWLEY.

**The Philosophy of Handwriting.** By DON FELIX DE SALAMANCA.

**By Stream and Sea.** By WILLIAM SENIOR.

**Old Stories Re-told.** By WALTER THORNBURY.

**Leaves from a Naturalist's Notebook.** By DR. ANDREW WILSON.

**Medicine, Family.**—One Thousand Medical Maxims and Surgical Hints, for Infancy, Adult Life, Middle Age, and Old Age. By N. E. DAVIES, Licentiate of the Royal College of Physicians of London. Crown 8vo, 1s.; cloth, 1s. 6d.

**Merry Circle (The):** A Book of New Intellectual Games and Amusements. By CLARA BELLEVUE. With numerous Illustrations. Crown 8vo, cloth extra, 4s. 6d.

**Middlemass (Jean), Novels by:** Touch and Go. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illust. bds., 2s. Mr. Dorillion. Post 8vo, illust. bds., 2s.

**Miller.**—**Physiology for the Young;** or, The House of Life: Human Physiology, with its application to the Preservation of Health. For use in Classes and Popular Reading. With numerous Illustrations. By Mrs. F. FENWICK MILLER. Small 8vo, cloth limp, 2s. 6d.

**Milton (J. L.), Works by:**

**The Hygiene of the Skin.** A Concise Set of Rules for the Management of the Skin; with Directions for Diet, Wines, Soaps, Baths, &c. Small 8vo, 1s.; cloth extra, 1s. 6d.

**The Bath in Diseases of the Skin.** Small 8vo, 1s.; cloth extra, 1s. 6d.

**The Laws of Life, and their Relation to Diseases of the Skin.** Small 8vo, 1s.; cloth extra, 1s. 6d.

## BOOKS PUBLISHED BY

**Moncrieff. — The Abdication ;** or, Time Tries All. An Historical Drama. By W. D. SCOTT-MONCRIEFF. With Seven Etchings by JOHN PETTIE, R.A., W. Q. ORCHARDSON, R.A., J. MACWHIRTER, A.R.A., COLIN HUNTER, R. MACBETH, and TOM GRAHAM. Large 4to, bound in buckram, 21s.

**Murray (D. Christie), Novels** by. Crown 8vo, cloth extra, 3s. 6d. each ; post 8vo, illustrated boards, 2s. each.

A Life's Atonement.

A Model Father.

Joseph's Coat.

Coals of Fire.

By the Gate of the Sea.

Crown 8vo, cloth extra, 3s. 6d. each.

**Val Strange: A Story of the Primrose Way.**

Hearts.

**The Way of the World.** Three Vols., crown 8vo.

**North Italian Folk.** By Mrs. COMYNS CARR. Illust. by RANDOLPH CALDECOTT. Square 8vo, cloth extra, 7s. 6d.

**Number Nip (Stories about),** the Spirit of the Giant Mountains. Retold for Children by WALTER GRAHAME. With Illustrations by J. MOYR SMITH. Post 8vo, cloth extra, 5s.

**Nursery Hints: A Mother's Guide in Health and Disease.** By N. E. DAVIES, L.R.C.P. Crown 8vo, 1s.; cloth, 1s. 6d.

**Oliphant. — Whiteladies: A Novel.** With Illustrations by ARTHUR HOPKINS and HENRY WOODS. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**O'Reilly. — Phoebe's Fortunes: A Novel.** With Illustrations by HENRY TUCK. Post 8vo, illustrated boards, 2s.

**O'Shaughnessy (Arth.), Works** by:

**Songs of a Worker.** Fcap. 8vo, cloth extra, 7s. 6d.

**Music and Moonlight.** Fcap. 8vo, cloth extra, 7s. 6d.

**Lays of France.** Crown 8vo, cloth extra, 10s. 6d.

**Ouida, Novels by.** Crown 8vo, cloth extra, 5s. each; post 8vo, illustrated boards, 2s. each.

**Held in Bondage.**

**Strathmore.**

**Chandos.**

**Under Two Flags.**

**Cecil Castle.**

**Idalia.**

**Tricotrin.**

**Puck.**

**Folle Farine.**

**Two Little Wooden Shoes.**

**A Dog of Flanders.**

**Pascarel.**

**Signa.**

**In a Winter City.**

**Ariadne.**

**Friendship.**

**Moths.**

**Pipistrello.**

**A Village Commune.**

**Bimbi.**

**In Maremma.**

**Wanda: A Novel.** Crown 8vo, cloth extra, 5s.

**Frescoes: Dramatic Sketches.** Crown 8vo, cloth extra, 10s. 6d.

**Bimbi: PRESENTATION EDITION.** Sq. 8vo, cloth gilt, cinnamon edges, 7s. 6d.

**Princess Napraxine.** Three Vols., crown 8vo. [Shortly.]

**Wisdom, Wit, and Pathos.** Selected from the Works of OUIDA by F. SYDNEY MORRIS. Small crown 8vo, cloth extra, 5s.

**Page (H. A.), Works by:**

**Thoreau: His Life and Aims: A Study.** With a Portrait. Post 8vo, cloth limp, 2s. 6d.

**Lights on the Way: Some Tales within a Tale.** By the late J. H. ALEXANDER, B.A. Edited by H. A. PAGE. Crown 8vo, cloth extra, 6s.

**Pascal's Provincial Letters.** A New Translation, with Historical Introduction and Notes, by T. M'CRIE, D.D. Post 8vo, cloth limp, 2s.

**Paul Ferroll:**

Post 8vo, illustrated boards, 2s. each.

**Paul Ferroll: A Novel.**

**Why Paul Ferroll Killed His Wife.**

**Paul.—Gentle and Simple.** By MARGARET AGNES PAUL. With a Frontispiece by HELEN PATERSON. Cr. 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Payn (James), Novels by.**

Crown 8vo, cloth extra, 3s. 6d. each;  
post 8vo, illustrated boards, 2s. each.

Lost Sir Massingberd.

The Best of Husbands

Walter's Word.

Halves.

| Fallen Fortunes.

What He Cost Her.

Less Black than We're Painted.

By Proxy.

| High Spirits.

Under One Roof. | Carlyon's Year.

A Confidential Agent.

Some Private Views.

From Exile.

A Grape from a Thorn.

For Cash Only.

Post 8vo, illustrated boards, 2s. each.

A Perfect Treasure.

Bentinck's Tutor.

Murphy's Master.

A County Family. | At Her Mercy.

A Woman's Vengeance.

Cecil's Tryst.

The Clyffards of Clyffe.

The Family Scapegrace

The Foster Brothers.

Found Dead.

Gwendoline's Harvest.

Humorous Stories.

Like Father, Like Son.

A Marine Residence.

Married Beneath Him.

Mirk Abbey.

Not Wooded, but Won.

Two Hundred Pounds Reward.

Kit: A Memory. Crown 8vo, cloth extra, 3s. 6d.

The Canon's Ward. Three Vols., crown 8vo.

**Pennell (H. Cholmondeley),**

Works by: Post 8vo, cloth limp, 2s. 6d. each.

Puck on Pegasus. With Illustrations.

The Muses of Mayfair. Vers de Société, Selected and Edited by H. C. PENNELL.

Pegasus Re-Saddled. With Ten full-page Illusts. by G. DU MAURIER.

**Phelps.—Beyond the Gates.**

By ELIZABETH STUART PHELPS, Author of "The Gates Ajar." Crown 8vo, cloth extra, 2s. 6d. Published by special arrangement with the Author, and Copyright in England and its Dependencies.

**Pirkis.—Trooping with Crows:**

A Story. By CATHERINE PIKIS. Fcap. 8vo, picture cover, 1s.

**Planche (J. R.), Works by:**

The Cyclopædia of Costume; or, A Dictionary of Dress—Regal, Ecclesiastical, Civil, and Military—from the Earliest Period in England to the Reign of George the Third, Including Notices of Contemporaneous Fashions on the Continent, and a General History of the Costumes of the Principal Countries of Europe. Two Vols., demy 4to, half morocco, profusely illustrated with Coloured and Plain Plates and Woodcuts, £7 7s. The Vols. may also be had separately (each complete in itself) at £3 13s. 6d. each: Vol. I. THE DICTIONARY. Vol. II. A GENERAL HISTORY OF COSTUME IN EUROPE.

The Pursuivant of Arms; or, Heraldry Founded upon Facts, With Coloured Frontispiece and 200 Illustrations. Crown 8vo, cloth extra, 7s. 6d.

Songs and Poems, from 1819 to 1879. Edited, with an Introduction, by his Daughter, Mrs. MACRARNES. Crown 8vo, cloth extra, 6s.

Play-time: Sayings and Doings of Babyland. By EDWARD STANFORD. Large 4to, handsomely printed in Colours, 5s.

**Plutarch's Lives of Illustrious**

Men. Translated from the Greek, with Notes Critical and Historical, and a Life of Plutarch, by JOHN and WILLIAM LANGHORNE. Two Vols., 8vo, cloth extra, with Portraits, 10s. 6d.

**Poe (Edgar Allan):—**

The Choice Works, in Prose and Poetry, of EDGAR ALLAN POE. With an Introductory Essay by CHARLES BAUDELAIRE, Portrait and Facsimiles. Crown 8vo, cloth extra, 7s. 6d.

The Mystery of Marie Roget, and other Stories. Post 8vo, illustrated boards, 2s.

**Pope's Poetical Works.**

Complete in One Volume. Post 8vo, cloth limp, 2s.

**Price (E. C.), Novels by:**

Valentina: A Sketch. With a Frontispiece by HAL LUDLOW. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

The Foreigners. Crown 8vo, cloth extra, 3s. 6d. [Shortly]

**Proctor (Richd. A.), Works by :**

**Flowers of the Sky.** With 55 Illustrations. Small crown 8vo, cloth extra, 4s. 6d.

**Easy Star Lessons.** With Star Maps for Every Night in the Year, Drawings of the Constellations, &c. Crown 8vo, cloth extra, 6s.

**Familiar Science Studies.** Crown 8vo, cloth extra, 7s. 6d.

**Rough Ways made Smooth:** A Series of Familiar Essays on Scientific Subjects. Cr. 8vo, cloth extra, 6s.

**Our Place among Infinities:** A Series of Essays contrasting our Little Abode in Space and Time with the Infinities Around us. Crown 8vo, cloth extra, 6s.

**The Expanse of Heaven:** A Series of Essays on the Wonders of the Firmament. Cr. 8vo, cloth extra, 6s.

**Saturn and its System.** New and Revised Edition, with 13 Steel Plates. Demy 8vo, cloth extra, 10s. 6d.

**The Great Pyramid:** Observatory, Tomb, and Temple. With Illustrations. Crown 8vo, cloth extra, 6s.

**Mysteries of Time and Space.** With Illustrations. Crown 8vo, cloth extra, 7s. 6d.

**Wages and Wants of Science Workers.** Crown 8vo, 1s 6d.

**Pyrotechnist's Treasury (The);** or, Complete Art of Making Fireworks. By THOMAS KENTISH. With numerous Illustrations. Cr. 8vo, cl. extra, 4s. 6d.

**Rabelais' Works.** Faithfully Translated from the French, with variorum Notes, and numerous characteristic Illustrations by GUSTAVE DORÉ. Crown 8vo, cloth extra, 7s. 6d.

**Rambosson.—Popular Astronomy.** By J. RAMBOSSON, Laureate of the Institute of France. Translated by C. B. PITMAN. Crown 8vo, cloth gilt, with numerous Illustrations, and a beautifully executed Chart of Spectra, 7s. 6d.

**Reader's Handbook (The) of Allusions, References, Plots, and Stories.** By the Rev. Dr. BREWER. Third Edition, revised throughout, with a New Appendix, containing a COMPLETE ENGLISH BIBLIOGRAPHY. Crown 8vo, 1,400 pages, cloth extra, 7s. 6d.

**Richardson.—A Ministry of Health, and other Papers.** By BENJAMIN WARD RICHARDSON, M.D., &c. Crown 8vo, cloth extra, 6s.

**Reade (Charles, D.C.L.), Novels** by. Post 8vo, illustrated boards, 2s. each; or crown 8vo, cloth extra, illustrated, 3s. 6d. each.

**Peg Woffington.** Illustrated by S. L. FILDES, A.R.A.

**Christie Johnstone.** Illustrated by WILLIAM SMALL.

**It is Never Too Late to Mend.** Illustrated by G. J. PINWELL.

**The Course of True Love Never did run Smooth.** Illustrated by HELEN PATERSON.

**The Autobiography of a Thief; Jack of all Trades; and James Lambert.** Illustrated by MATT STRETCH.

**Love me Little, Love me Long.** Illustrated by M. ELLEN EDWARDS.

**The Double Marriage.** Illustrated by Sir JOHN GILBERT, R.A., and CHARLES KEENE.

**The Cloister and the Hearth.** Illustrated by CHARLES KEENE.

**Hard Cash.** Illustrated by F. W. LAWSON.

**Griffith Gaunt.** Illustrated by S. L. FILDES, A.R.A., and WM. SMALL.

**Foul Play.** Illustrated by GEORGE DU MAURIER.

**Put Yourself in His Place.** Illustrated by ROBERT BARNES.

**A Terrible Temptation.** Illustrated by EDW. HUGHES and A. W. COOPER.

**The Wandering Heir.** Illustrated by HELEN PATERSON, S. L. FILDES, A.R.A., CHARLES GREEN, and HENRY WOODS, A.R.A.

**A Simpleton.** Illustrated by KATE CRAUFORD.

**A Woman-Hater.** Illustrated by THOS. COULDERY.

**Readiana.** With a Steel Plate Portrait of CHARLES READE.

**A New Collection of Stories.** In Three Vols., crown 8vo. [Preparing.]

**Riddell (Mrs. J. H.), Novels by:** Crown 8vo, cloth extra, 3s. 6d. each; post 8vo, illustrated boards, 2s. each.

**Her Mother's Darling.**

**The Prince of Wales's Garden Party.**

**Rimmer (Alfred), Works by :**

**Our Old Country Towns.** With over 50 Illusts. Sq. 8vo, cloth gilt, 10s. 6d.

**Rambles Round Eton and Harrow.** 50 Illusts. Sq. 8vo, cloth gilt, 10s. 6d.

**About England with Dickens.** With 58 Illustrations by ALFRED RIMMER and C. A. VANDERHOOF. Square 8vo cloth gilt, 10s. 6d.

**Robinson (F. W.), Novels by:**

*Women are Strange.* Cr. 8vo, cloth extra, 3s. 6d.; post 8vo, illust. bds., 2s.  
*The Hands of Justice.* Crown 8vo, cloth extra, 3s. 6d.

**Robinson (Phil), Works by:**

*The Poets' Birds.* Crown 8vo, cloth extra, 7s. 6d.

*The Poets' Beasts.* Crown 8vo, cloth extra, 7s. 6d. [*In preparation.*]

**Robinson Crusoe:** A beautiful reproduction of Major's Edition, with 37 Woodcuts and Two Steel Plates by GEORGE CRUIKSHANK, choicely printed. Crown 8vo, cloth extra, 7s. 6d. 100 Large-Paper copies, printed on hand-made paper, with India proofs of the Illustrations, price 36s.

**Roche foucauld's Maxims and Moral Reflections.** With Notes, and an Introductory Essay by SAINTE-BEUVE. Post 8vo, cloth limp, 2s.

**Roll of Battle Abbey, The;** or, A List of the Principal Warriors who came over from Normandy with William the Conqueror, and Settled in this Country, A.D. 1066-7. With the principal Arms emblazoned in Gold and Colours. Handsomely printed, price 5s.

**Rowley (Hon. Hugh), Works by:**  
 Post 8vo, cloth limp, 2s. 6d. each.

*Puniana: Riddles and Jokes.* With numerous Illustrations.

*More Puniana.* Profusely Illustrated.

**Russell (Clark).—Round the Galley-Fire.** By W. CLARK RUSSELL, Author of "The Wreck of the Grosvenor." Cr. 8vo, cloth extra, 6s.

**Sala.—Gaslight and Daylight.** By GEORGE AUGUSTUS SALA. Post 8vo, illustrated boards, 2s.

**Sanson.—Seven Generations of Executioners:** Memoirs of the Sanson Family (1658 to 1847). Edited by HENRY SANSON. Crown 8vo, cloth extra, 3s. 6d.

**Saunders (John), Novels by:**  
 Crown 8vo, cloth extra, 3s. 6d. each;  
 post 8vo, illustrated boards, 2s. each.

*Bound to the Wheel.*  
*One Against the World.*  
*Guy Waterman.*  
*The Lion in the Path.*  
*The Two Dreamers.*

**Science Gossip: An Illustrated**

Medium of Interchange for Students and Lovers of Nature. Edited by J. E. TAYLOR, F.L.S., &c. Devoted to Geology, Botany, Physiology, Chemistry, Zoology, Microscopy, Telescoping, Physiography, &c. Price 4d. Monthly; or 5s. per year, post free. It contains Original Illustrated Articles by the best-known Writers and Workers of the day. A Monthly Summary of Discovery and Progress in every department of Natural Science is given. Large space is devoted to Scientific "Notes and Queries," thus enabling every lover of nature to chronicle his own original observations, or get his special difficulties settled. For active workers and collectors the "Exchange Column" has long proved a well and widely known means of barter and exchange. The column devoted to "Answers to Correspondents" has been found helpful to students requiring personal help in namingspecimens, &c. The Volumes of *Science Gossip* for the last eighteen years contain an unbroken History of the advancement of Natural Science within that period. Each Number contains a Coloured Plate and numerous Woodcuts. Vols. I. to XIV. may be had at 7s. 6d. each; and Vols. XV. to XIX. (1883), at 5s. each.

**"Secret Out" Series, The:**  
 Crown 8vo, cloth extra, profusely Illustrated, 4s. 6d. each.

*The Secret Out: One Thousand Tricks with Cards, and other Recreations; with Entertaining Experiments in Drawing-room or "White Magic."* By W. H. CREMER. 300 Engravings.

*The Pyrotechnist's Treasury;* or, Complete Art of Making Fireworks. By THOMAS KENTISH. With numerous Illustrations.

*The Art of Amusing:* A Collection of Graceful Arts, Games, Tricks, Puzzles, and Charades. By FRANK BELLEW. With 300 Illustrations.

*Hanky-Panky:* Very Easy Tricks, Very Difficult Tricks, White Magic, Sleight of Hand. Edited by W. H. CREMER. With 200 Illustrations.

*The Merry Circle:* A Book of New Intellectual Games and Amusements. By CLARA BELLEW. With many Illustrations.

*Magician's Own Book:* Performances with Cups and Balls, Eggs, Hats, Handkerchiefs, &c. All from actual Experience. Edited by W. H. CREMER. 200 Illustrations.

## THE "SECRET OUT" SERIES, continued—

**Magie No Mystery:** Tricks with Cards, Dice, Balls, &c., with fully descriptive Directions; the Art of Secret Writing; Training of Performing Animals, &c. With Coloured Frontispiece and many Illustrations.

**Senior (William), Works by :**

**Travel and Trout in the Antipodes.** Crown 8vo, cloth extra, 6s.

**By Stream and Sea.** Post 8vo, cloth limp, 2s. 6d.

**Seven Sagas (The) of Prehistoric Man.** By JAMES H. STODDART, Author of "The Village Life." Crown 8vo, cloth extra, 6s.

**Shakespeare :**

**The First Folio Shakespeare.**—MR. WILLIAM SHAKESPEARE'S Comedies, Histories, and Tragedies. Published according to the true Originall Copies. London, Printed by ISAAC IAGGARD and ED. BLOUNT. 1623.—A Reproduction of the extremely rare original, in reduced facsimile, by a photographic process—ensuring the strictest accuracy in every detail. Small 8vo, half-Roxburghe, 7s. 6d.

**The Lansdowne Shakespeare.** Beautifully printed in red and black, in small but very clear type. With engraved facsimile of DROESHOUT'S Portrait. Post 8vo, cloth extra, 7s. 6d.

**Shakespeare for Children: Tales from Shakespeare.** By CHARLES and MARY LAMB. With numerous Illustrations, coloured and plain, by J. MOYR SMITH. Crown 4to, cloth gilt, 6s.

**The Handbook of Shakespeare Music.** Being an Account of 350 Pieces of Music, set to Words taken from the Plays and Poems of Shakespeare, the compositions ranging from the Elizabethan Age to the Present Time. By ALFRED ROFFE. 4to, half-Roxburghe, 7s.

**A Study of Shakespeare.** By ALGERNON CHARLES SWINBURNE. Crown 8vo, cloth extra, 8s.

**Shelley's Complete Works, in Four Vols.,** post 8vo, cloth limp, 8s.; or separately, 2s. each. Vol. I. contains his Early Poems, *Queen Mab*, &c., with an Introduction by LEIGH HUNT; Vol. II., his Later Poems, *Laon and Cythna*, &c.; Vol. III., Posthumous Poems, the *Shelley Papers*, &c.; Vol. IV., his Prose Works, including *A Refutation of Deism*, *Zastrozzi*, *St. Irvyne*, &c.

**Sheridan's Complete Works,** with Life and Anecdotes. Including his Dramatic Writings, printed from the Original Editions, his Works in Prose and Poetry, Translations, Speeches, Jokes, Puns, &c. With a Collection of Sheridaniana. Crown 8vo, cloth extra, gilt, with 10 full-page Tinted Illustrations, 7s. 6d.

**Short Sayings of Great Men.** With Historical and Explanatory Notes by SAMUEL A. BENT, M.A. Demy 8vo, cloth extra, 7s. 6d.

**Sidney's (Sir Philip) Complete Poetical Works,** including all those in "Arcadia." With Portrait, Memorial-Introduction, Essay on the Poetry of Sidney, and Notes, by the Rev. A. B. GROSART, D.D. Three Vols., crown 8vo, cloth boards, 18s.

**Signboards: Their History.** With Anecdotes of Famous Taverns and Remarkable Characters. By JACOB LARWOOD and JOHN CAMDEN HOTTEN. Crown 8vo, cloth extra, with 100 Illustrations, 7s. 6d.

**Sims (G. R.), Works by :**

**How the Poor Live.** With 60 Illustrations by FRED. BARNARD. Large 4to, 1s.

**Horrible London.** Reprinted, with Additions, from the *Daily News*. Large 4to, 6d. [Shortly.]

**Sketchley.—A Match in the Dark.** By ARTHUR SKETCHLEY. Post 8vo, illustrated boards, 2s.

**Slang Dictionary, The: Etymological, Historical, and Anecdotal.** Crown 8vo, cloth extra, gilt, 6s. 6d.

**Smith (J. Moyr), Works by :**

**The Prince of Argolis: A Story of the Old Greek Fairy Time.** By J. MOYR SMITH. Small 8vo, cloth extra, with 130 Illustrations, 3s. 6d.

**Tales of Old Thule.** Collected and Illustrated by J. MOYR SMITH. Crown 8vo, cloth gilt, profusely illustrated, 6s.

**The Wooling of the Water Witch: A Northern Oddity.** By EVAN DALDORNE. Illustrated by J. MOYR SMITH. Small 8vo, cloth extra, 6s.

**South-West, The New: Traveling Sketches from Kansas, New Mexico, Arizona, and Northern Mexico.** By ERNST VON HESSE-WARTTIG. With 100 fine Illustrations and 3 Maps. 8vo, cloth extra, 14s. [In preparation.]

**Spalding.**—Elizabethan Demonology: An Essay in Illustration of the Belief in the Existence of Devils, and the Powers possessed by Them. By T. ALFRED SPALDING, LL.B. Crown 8vo, cloth extra, 5s.

**Speight.**—The Mysteries of Heron Dyke. By T. W. SPEIGHT. With a Frontispiece by M. ELLEN EDWARDS. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Spenser for Children.** By M. H. TOWRY. With Illustrations by WALTER J. MORGAN. Crown 4to, with Coloured Illustrations, cloth gilt, 6s.

**Staunton.**—Laws and Practice of Chess; Together with an Analysis of the Openings, and a Treatise on End Games. By HOWARD STAUNTON. Edited by ROBERT B. WORMALD. New Edition, small cr. 8vo, cloth extra, 5s.

**Sterndale.**—The Afghan Knife: A Novel. By ROBERT ARMITAGE STERNDALÉ. Cr. 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Stevenson (R. Louis), Works by:** Travels with a Donkey in the Cevennes. Frontispiece by WALTER CRANE. Post 8vo, cloth limp, 2s. 6d.

An Inland Voyage. With a Frontispiece by WALTER CRANE. Post 8vo, cloth limp, 2s. 6d.

Virginibus Puerisque, and other Papers. Crown 8vo, cloth extra, 6s.

Familiar Studies of Men and Books. Crown 8vo, cloth extra, 6s.

New Arabian Nights. Crown 8vo, cl. extra, 6s.; post 8vo, illust. bds., 2s.

The Silverado Squatters. With Frontispiece. Cr. 8vo, cloth extra, 6s.

**St. John.**—A Levantine Family. By BAYLE ST. JOHN. Post 8vo, illustrated boards, 2s.

**Stoddard.**—Summer Cruising in the South Seas. By CHARLES WARREN STODDARD. Illustrated by WALLIS MACKAY. Crown 8vo, cloth extra, 3s. 6d.

**St. Pierre.**—Paul and Virginia, and The Indian Cottage. By BERNARDIN DE ST. PIERRE. Edited, with Life, by the Rev. E. CLARKE. Post 8vo, cloth limp, 2s.

**Stories from Foreign Novels.** With Notices of their Lives and Writings. By HELEN and ALICE ZIMMERN; and a Frontispiece. Crown 8vo cloth extra, 3s. 6d.

**Strutt's Sports and Pastimes of the People of England;** including the Rural and Domestic Recreations, May Games, Mummeries, Shows, Processions, Pageants, and Pompous Spectacles, from the Earliest Period to the Present Time. With 140 Illustrations. Edited by WILLIAM HONE. Crown 8vo, cloth extra, 7s. 6d.

**Suburban Homes (The) of London:** A Residential Guide to Favourite London Localities, their Society, Celebrities, and Associations. With Notes on their Rental, Rates, and House Accommodation. With a Map of Suburban London. Crown 8vo, cloth extra, 7s. 6d.

**Swift's Choice Works, in Prose and Verse.** With Memoir, Portrait, and Facsimiles of the Maps in the Original Edition of "Gulliver's Travels." Cr. 8vo, cloth extra, 7s. 6d.

**Swinburne (Algernon C.), Works by:**

The Queen Mother and Rosamond. Fcap. 8vo, 5s.

Atalanta in Calydon. Crown 8vo, 6s.

Chastelard. A Tragedy. Crown 8vo, 7s.

Poems and Ballads. FIRST SERIES. Fcap. 8vo, 9s. Also in crown 8vo, at same price.

Poems and Ballads. SECOND SERIES. Fcap. 8vo, 9s. Also in crown 8vo, at same price.

Notes on Poems and Reviews. 8vo, 1s.

William Blake: A Critical Essay. With Facsimile Paintings. Demy 8vo, 16s.

Songs before Sunrise. Crown 8vo, 10s. 6d.

Bothwell: A Tragedy. Crown 8vo, 12s. 6d.

George Chapman: An Essay. Crown 8vo, 7s.

Songs of Two Nations. Cr. 8vo, 6s.

Essays and Studies. Crown 8vo, 12s.

Erechtheus: A Tragedy. Crown 8vo, 6s.

Note of an English Republican on the Muscovite Crusade. 8vo, 1s.

A Note on Charlotte Brontë. Crown 8vo, 6s.

A Study of Shakespeare. Crown 8vo, 8s.

Songs of the Springtides. Crown 8vo, 6s.

Studies in Song. Crown 8vo, 7s.

A. C. SWINEBURNE'S WORKS, *continued*—  
 Mary Stuart: A Tragedy. Crown  
 8vo, 8s.

Tristram of Lyonesse, and other  
 Poems. Crown 8vo, 9s.

A Century of Roundels. Small 4to,  
 cloth extra, 8s.

Syntax's (Dr.) Three Tours:  
 In Search of the Picturesque, in Search  
 of Consolation, and in Search of a  
 Wife. With the whole of ROWLAND-  
 SON'S droll page Illustrations in Colours  
 and a Life of the Author by J. C.  
 HOTTEN. Medium 8vo, cl. extra, 7s. 6d.

Taine's History of English  
 Literature. Translated by HENRY  
 VAN LAUN. Four Vols., small 8vo,  
 cloth boards, 30s.—POPULAR EDITION,  
 Two Vols., crown 8vo, cloth extra, 15s.

Taylor (Dr.).—The Sagacity  
 and Morality of Plants: A Sketch  
 of the Life and Conduct of the Vege-  
 table Kingdom. By J. E. TAYLOR,  
 F.L.S., &c. With Coloured Frontis-  
 piece and 100 Illustrations. Crown 8vo,  
 cloth extra, 7s. 6d.

Taylor's (Bayard) Diversions  
 of the Echo Club: Burlesques of  
 Modern Writers. Post 8vo, cl. limp, 2s.

Taylor's (Tom) Historical  
 Dramas: "Clancarty," "Jeanne  
 Darc," "Twixt Axe and Crown,"  
 "The Fool's Revenge," "Arkwright's  
 Wife," "Anne Holeyn," "Plot and  
 Passion." One Vol., crown 8vo, cloth  
 extra, 7s. 6d.

\* The Plays may also be had sepa-  
 rately, at 1s. each.

Thackerayana: Notes and Anec-  
 dotes. Illustrated by Hundreds of  
 Sketches by WILLIAM MAKEPEACE  
 THACKERAY, depicting Humorous  
 Incidents in his School-life, and  
 Favourite Characters in the books of  
 his every-day reading. With Coloured  
 Frontispiece. Cr. 8vo, cl. extra, 7s. 6d.

Thomas (Bertha), Novels by.  
 Crown 8vo, cloth extra, 3s. 6d. each;  
 post 8vo, illustrated boards, 2s. each.  
 Cressida.  
 Proud Maisie.  
 The Violin Player.

Thomson's Seasons and Castle  
 of Indolence. With a Biographical  
 and Critical Introduction by ALLAN  
 CUNNINGHAM, and over 50 fine Illustra-  
 tions on Steel and Wood. Crown 8vo,  
 cloth extra, gilt edges, 7s. 6d.

Thomas (M.).—A Fight for Life:  
 A Novel. By W. MOY THOMAS. Post  
 8vo, illustrated boards, 2s.

Thornbury (Walter), Works by  
 Haunted London. Edited by ED-  
 WARD WALFORD, M.A. With Illus-  
 trations by F. W. FAIRHOLT, F.S.A.  
 Crown 8vo, cloth extra, 7s. 6d.

The Life and Correspondence of  
 J. M. W. Turner. Founded upon  
 Letters and Papers furnished by his  
 Friends and fellow Academicians.  
 With numerous Illustrations in  
 Colours, facsimiled from Turner's  
 Original Drawings. Crown 8vo, cloth  
 extra, 7s. 6d.

Old Stories Re-told. Post 8vo, cloth  
 limp, 2s. 6d.

Tales for the Marines. Post 8vo,  
 illustrated boards, 2s.

Timbs (John), Works by:

The History of Clubs and Club Life  
 in London. With Anecdotes of its  
 Famous Coffee-houses, Hostelties,  
 and Taverns. With numerous Illus-  
 trations. Cr. 8vo, cloth extra, 7s. 6d.

English Eccentrics and Eccen-  
 tricities: Stories of Wealth and  
 Fashion, Delusions, Impositions, and  
 Fanatic Missions, Strange Sights  
 and Sporting Scenes, Eccentric  
 Artists, Theatrical Folks, Men of  
 Letters, &c. With nearly 50 Illus-  
 trations. Crown 8vo, cloth extra, 7s. 6d.

Torrens. — The Marquess  
 Wellesley, Architect of Empire. An  
 Historic Portrait. By W. M. TOR-  
 RENS, M.P. Demy 8vo, cloth extra, 14s.

Trollope (Anthony), Novels by:  
 Crown 8vo, cloth extra, 3s. 6d. each;  
 post 8vo, illustrated boards, 2s. each.

The Way We Live Now.

The American Senator.

Kept in the Dark.

Frau Frohmann.

Marion Fay.

Mr. Scarborough's Family. Crown  
 8vo, cloth extra, 3s. 6d.

The Land-Leaguers. Crown 8vo,  
 cloth extra, 3s. 6d. [Sherry.]

Trollope (Frances E.), Novels by  
 Like Ships upon the Sea. Crown  
 8vo, cloth extra, 3s. 6d.; post 8vo,  
 illustrated boards, 2s.

Mabel's Progress. Crown 8vo, cloth  
 extra, 3s. 6d.

Anne Furness. Crown 8vo, cloth  
 extra, 3s. 6d.

**Trollope (T. A.).—Diamond Cut Diamond,** and other Stories. By THOMAS ADOLPHUS TROLLOPE. Crown 8vo, cloth extra, 3s. 6d.; post 8vo, illustrated boards, 2s.

**Tytler (Sarah), Novels by:**

Crown 8vo, cloth extra, 3s. 6d. each; post 8vo, illustrated boards, 2s. each.

**What She Came Through.**

**The Bride's Pass.**

**Van Laun.—History of French Literature.** By HENRY VAN LAUN. Complete in Three Vols., demy 8vo, cloth boards, 7s. 6d. each.

**Villari.—A Double Bond: A Story.** By LINDA VILLARI. Fcap. 8vo, picture cover, 1s.

**Walcott.—Church Work and Life in English Minsters; and the English Student's Monasticism.** By the REV. MACKENZIE E. C. WALCOTT, B.D. Two Vols., crown 8vo, cloth extra, with Map and Ground-Plans, 14s.

**Walford (Edw., M.A.), Works by:**

**The County Families of the United Kingdom.** Containing Notices of the Descent, Birth, Marriage, Education, &c., of more than 12,000 distinguished Heads of Families, their Heirs Apparent or Presumptive, the Offices they hold or have held, their Town and Country Addresses, Clubs, &c. Twenty-fourth Annual Edition, for 1884, cloth, full gilt, 50s. (*Shortly*).

**The Shilling Peerage (1884).** Containing an Alphabetical List of the House of Lords, Dates of Creation, Lists of Scotch and Irish Peers, Addresses, &c. 32mo, cloth, 1s. Published annually.

**The Shilling Baronetage (1884).** Containing an Alphabetical List of the Baronets of the United Kingdom, short Biographical Notices, Dates of Creation, Addresses, &c. 32mo, cloth, 1s. Published annually.

**The Shilling Knightage (1884).** Containing an Alphabetical List of the Knights of the United Kingdom, short Biographical Notices, Dates of Creation, Addresses, &c. 32mo, cloth, 1s. Published annually.

**The Shilling House of Commons (1884).** Containing a List of all the Members of the British Parliament, their Town and Country Addresses, &c. 32mo, cloth, 1s. Published annually.

**EDW. WALFORD'S WORKS, continued—**

**The Complete Peerage, Baronetage, Knightage, and House of Commons (1884).** In One Volume, royal 32mo, cloth extra, gilt edges, 5s. Published annually.

**Haunted London.** By WALTER THORNBURY. Edited by EDWARD WALFORD, M.A. With Illustrations by F. W. FAIRHOLT, F.S.A. Crown 8vo, cloth extra, 7s. 6d.

**Walton and Cotton's Complete**

**Angler; or, The Contemplative Man's Recreation; being a Discourse of Rivers, Fishponds, Fish and Fishing,** written by IZAAK WALTON; and Instructions how to Angle for a Trout or Grayling in a clear Stream, by CHARLES COTTON. With Original Memoirs and Notes by Sir HARRIS NICOLAS, and 61 Copperplate Illustrations. Large crown 8vo, cloth antique, 7s. 6d.

**Wanderer's Library, The:**

Crown 8vo, cloth extra, 3s. 6d. each.

**Wanderings in Patagonia; or, Life among the Ostrich Hunters.** By JULIUS BEERBOHM. Illustrated.

**Camp Notes: Stories of Sport and Adventure in Asia, Africa, and America.** By FREDERICK BOYLE.

**Savage Life.** By FREDERICK BOYLE.

**Merrle England in the Olden Time.** By GEORGE DANIEL. With Illustrations by ROBT. CRUIKSHANK.

**Circus Life and Circus Celebrities.** By THOMAS FROST.

**The Lives of the Conjurors.** By THOMAS FROST.

**The Old Showmen and the Old London Fairs.** By THOMAS FROST.

**Low-Life Deepes.** An Account of the Strange Fish to be found there. By JAMES GREENWOOD.

**The Wilds of London.** By JAMES GREENWOOD.

**Tunls: The Land and the People.** By the Chevalier de HESSE-WARTEGG. With 22 Illustrations.

**The Life and Adventures of a Cheap Jack.** By One of the Fraternity. Edited by CHARLES HINDLEY.

**The World Behind the Scenes.** By PERCY FITZGERALD.

**Tavern Anecdotes and Sayings.** Including the Origin of Signs, and Reminiscences connected with Taverns, Coffee Houses, Clubs, &c. By CHARLES HINDLEY. With Illusts.

**The Genial Showman: Life and Adventures of Artemus Ward.** By E. P. HINGSTON. With a Frontispiece.

THE WANDERER'S LIBRARY, *continued*—

**The Story of the London Parks.** By JACOB LARWOOD. With Illustrations.

**London Characters.** By HENRY MAYHEW. Illustrated.

**Seven Generations of Executioners:** Memoirs of the Sanson Family (1688 to 1847). Edited by HENRY SANSON.

**Summer Cruising in the South Seas.** By CHARLES WARREN STODDARD. Illustrated by WALLIS MACKAY.

**Warner.—A Roundabout Journey.** By CHARLES DUDLEY WARNER, Author of "My Summer in a Garden." Crown 8vo, cloth extra, 6s.

**Warrants, &c. :—**

**Warrant to Execute Charles I.** An exact Facsimile, with the Fifty-nine Signatures, and corresponding Seals. Carefully printed on paper to imitate the Original, 22 in. by 14 in. Price 2s.

**Warrant to Execute Mary Queen of Scots.** An exact Facsimile, including the Signature of Queen Elizabeth, and a Facsimile of the Great Seal. Beautifully printed on paper to imitate the Original MS. Price 2s.

**Magna Charta.** An Exact Facsimile of the Original Document in the British Museum, printed on fine plate paper, nearly 3 feet long by 2 feet wide, with the Arms and Seals emblazoned in Gold and Colours. Price 5s.

**The Roll of Battle Abbey; or, A List of the Principal Warriors who came over from Normandy with William the Conqueror, and Settled in this Country, A.D. 1066-7.** With the principal Arms emblazoned in Gold and Colours. Price 5s.

**Westropp.—Handbook of Pottery and Porcelain; or, History of those Arts from the Earliest Period.** By HODDER M. WESTROPP. With numerous Illustrations, and a List of Marks. Crown 8vo, cloth limp, 4s. 6d.

**Whistler v. Ruskin: Art and Art Critics.** By J. A. MACNEILL WHISTLER. Seventh Edition, square 8vo, 1s.

**White's Natural History of Selborne.** Edited, with Additions, by THOMAS BROWN, F.L.S. Post 8vo, cloth limp, 2s.

**Williams (W. Mattieu, F.R.A.S.),**

Works by:

**Science Notes.** See the GENTLEMAN'S MAGAZINE. 1s. Monthly.

**Science in Short Chapters.** Crown 8vo, cloth extra, 7s. 6d.

**A Simple Treatise on Heat.** Crown 8vo, cloth limp, with Illustrs., 2s. 6d.

**Wilson (Dr. Andrew, F.R.S.E.),**

Works by:

**Chapters on Evolution: A Popular History of the Darwinian and Allied Theories of Development.** Second Edition. Crown 8vo, cloth extra, with 259 illustrations, 7s. 6d.

**Leaves from a Naturalist's Notebook.** Post 8vo, cloth limp, 2s. 6d.

**Leisure-Time Studies, chiefly Biological.** Second Edition. Crown 8vo, cloth extra, with Illustrations, 6s.

**Wilson (C.E.).—Persian Wit and**

**Humour: Being the Sixth Book of the Baharistan of Jami, Translated for the first time from the Original Persian into English Prose and Verse.** With Notes by C. E. WILSON, M.R.A.S., Assistant Librarian Royal Academy of Arts. Cr. 8vo, parchment binding, 4s.

**Winter (J. S.), Stories by:**

Crown 8vo, cloth extra, 3s. 6d. each.  
post 8vo, illustrated boards, 2s. each.

**Cavalry Life.**

**Regimental Legends.**

**Wood.—Sabina: A Novel.** By

Lady Wood. Post 8vo, illustrated boards, 2s.

**Words, Facts, and Phrases:**

A Dictionary of Curious, Quaint, and Out-of-the-Way Matters. By ELIEZER EDWARDS. Cr. 8vo, half-bound, 12s. 6d.

**Wright (Thomas), Works by:**

**Caricature History of the Georges.** (The House of Hanover.) With 400 Pictures, Caricatures, Squibs, Broad-sides, Window Pictures, &c. Crown 8vo, cloth extra, 7s. 6d.

**History of Caricature and of the Grotesque in Art, Literature, Sculpture, and Painting.** Profusely Illustrated by F. W. FAIRHOLT, F.S.A. Large post 8vo, cloth extra, 7s. 6d.

**Yates (Edmund), Novels by:**

Post 8vo, illustrated boards 2s. each.

**Castaway.**

**The Forlorn Hope.**

**Land at Last.**

## NOVELS BY THE BEST AUTHORS.

At every Library.

- |  |  |
|--|--|
| Princess Napraxine. By OUIDA.<br>Three Vols. [Shortly.]      | Maid of Athens. By JUSTIN MCCARTHY,<br>M.P. With 12 Illustrations by FRED.<br>BARNARD. Three Vols. |
| Dorothy Forster. By WALTER<br>BESANT. Three Vols. [Shortly.] | The Canon's Ward. By JAMES PAYN.<br>Three Vols.  |
| The New Abelard. By ROBERT BUCHANAN. Three Vols.             | A Real Queen. By R. E. FRANCELLO.<br>Three Vols.   |
| Fancy-Free, &c. By CHARLES GIBBON.<br>Three Vols.            | A New Collection of Stories by<br>CHARLES READE. Three Vols.<br>[In preparation.]                  |
| Ione. E. LYNN LINTON. Three Vols.                            |  |
| The Way of the World. By D. CHRISTIE MURRAY. Three Vols.     |  |

## THE PICCADILLY NOVELS.

Popular Stories by the Best Authors. LIBRARY EDITIONS, many Illustrated, crown 8vo, cloth extra, 3s. 6d. each.

BY MRS. ALEXANDER.

Maid, Wife, or Widow?

BY W. BESANT & JAMES RICE.

Ready-Money Mortiboy.

My Little Girl.

The Case of Mr. Lucraft.

This Son of Vulcan.

With Harp and Crown.

The Golden Butterfly.

By Celia's Arbour.

The Monks of Thelema.

'Twas in Trafalgar's Bay.

The Seamy Side.

The Ten Years' Tenant.

The Chaplain of the Fleet.

BY WALTER BESANT.

All Sorts and Conditions of Men.

The Captain's Room.

BY ROBERT BUCHANAN.

A Child of Nature.

God and the Man.

The Shadow of the Sword.

The Martyrdom of Madeline.

Love Me for Ever.

BY MRS. H. LOVETT CAMERON.

Deceivers Ever.

Juliet's Guardian.

BY MORTIMER COLLINS.

Sweet Anne Page.

Transmigration.

From Midnight to Midnight.

MORTIMER & FRANCES COLLINS.

Blacksmith and Scholar.

The Village Comedy.

You Play me False.

BY WILKIE COLLINS.

Antonina.

Basil.

Hide and Seek.

The Dead Secret.

Queen of Hearts.

My Miscellanies.

Woman in White.

The Moonstone.

Man and Wife.

Poor Miss Finch.

Miss or Mrs.?

New Magdalen.

The Frozen Deep.

The Law and the

Lady.

The Two Destinies

Haunted Hotel

The Fallen Leaves

Jezabel's Daughter

The Black Robe.

Heart and Science

BY DUTTON COOK.

Paul Foster's Daughter

BY WILLIAM CYPLES.

Hearts of Gold.

BY JAMES DE MILLE.

A Castle in Spain.

BY J. LEITH DERWENT

Our Lady of Tears. | Circe's Lovers.

CHEAP POPULAR NOVELS, *continued*—

BY ROBERT BUCHANAN.

The Shadow of the Sword.  
A Child of Nature.  
God and the Man.  
The Martyrdom of Madelline.  
Love Me for Ever.

BY MRS. BURNETT.

Surly Tim.

BY MRS. LOYETT CAMERON.  
Deceivers Ever. | Juliet's Guardian.

BY MACLAREN COBBAN.

The Cure of Souls.

BY C. ALLSTON COLLINS.

The Bar Sinister.

BY WILKIE COLLINS.

Antonina.	Miss or Mrs.?
Basil.	The New Magda-
Hide and Seek.	len.
The Dead Secret.	The Frozen Deep.
Queen of Hearts.	Law and the Lady.
My Miscellanies.	The Two Destinies
Woman in White.	Haunted Hotel.
The Moonstone.	The Fallen Leaves.
Man and Wife.	Jezebel's Daughter
Poor Miss Finch.	The Black Robe.

BY MORTIMER COLLINS.

Sweet Anna Page.  
Transmigration.  
From Midnight to Midnight.  
A Fight with Fortune.

MORTIMER &amp; FRANCES COLLINS.

Sweet and Twenty. | Frances.  
Blacksmith and Scholar.  
The Village Comedy.  
You Play me False.

BY DUTTON COOK.

Leo. | Paul Foster's Daughter.

BY J. LEITH DERWENT.

Our Lady of Tears.

BY CHARLES DICKENS.

Sketches by Boz.  
The Pickwick Papers.  
Oliver Twist.  
Nicholas Nickleby.

BY MRS. ANNIE EDWARDES.  
A Point of Honour. | Archie Lovell.

BY M. BETHAM-EDWARDS.  
Felicia. | Kitty.

BY EDWARD EGGLESTON.  
Roxy.

CHEAP POPULAR NOVELS, *continued*—

BY PERCY FITZGERALD.

Bella Donna. | Never Forgotten.  
The Second Mrs. Tillotson.  
Polly.  
Seventy-five Brooke Street.

BY ALBANY DE FONBLANQUE.

Filthy Lucre.

BY R. E. FRANCILLON.

Olympia. | Queen Cophetua.  
One by One.

Prefaced by Sir H. BARTLE FRERE.

Pandurang Hari.

BY HAIN FRISWELL.

One of Two.

BY EDWARD GARRETT.

The Capel Girls.

BY CHARLES GIBBON.

Robin Gray.	Queen of the Mea-
For Lack of Gold.	dow.
What will the	In Pastures Green
World Say?	The Flower of the
In Honour Bound.	Forest.
The Dead Heart.	A Heart's Problem
In Love and War.	The Braces of Yar-
For the King.	row.

BY WILLIAM GILBERT.

Dr. Austin's Guests.  
The Wizard of the Mountain.  
James Duke.

BY JAMES GREENWOOD.

Dick Temple.

BY ANDREW HALLIDAY.

Every-Day Papers.

BY LADY DUFFUS HARDY.

Paul Wyntor's Sacrifice.

BY THOMAS HARDY.

Under the Greenwood Tree.

BY JULIAN HAWTHORNE.

Garth.	Sebastian Strome
Ellice Quentin.	Dust.
Prince Saroni's Wife.	

BY SIR ARTHUR HELPS.

Ivan de Biran.

BY TOM HOOD.

A Golden Heart.

BY MRS. GEORGE HOOPER.

The House of Raby.

BY VICTOR HUGO.

The Hunchback of Notre Dame.

CHEAP POPULAR NOVELS, continued—

BY MRS. ALFRED HUNT.

Thornicroft's Model.  
The Leaden Casket.  
Self-Condemed.

BY JEAN INGELow.

Fated to be Free.

BY HARRIETT JAY.

The Dark Colleen.  
The Queen of Connaught.

BY HENRY KINGSLEY.

Oakshott Castle. | Number Seventeen

BY E. LYNN LINTON.

Patricia Kemball.  
The Atonement of Leam Dundas.  
The World Well Lost.  
Under which Lord?  
With a Silken Thread.  
The Rebel of the Family.  
"My Love!"

BY HENRY W. LUCY.

Gideon Fleyce.

BY JUSTIN McCARTHY, M.P.

Dear Lady Disdain.  
The Waterdale Neighbours.  
My Enemy's Daughter.

A Fair Saxon.  
Linley Rochford.  
Miss Misanthrope.  
Donna Quixote.  
The Comet of a Season.

BY GEORGE MACDONALD.

Paul Faber, Surgeon.  
Thomas Wingfold, Curate.

BY MRS. MACDONELL.

Quaker Cousins.

BY KATHARINE S. MACQUOID.

The Evil Eye. | Lost Rose.

BY W. H. MALLOCK.

The New Republic.

BY FLORENCE MARRYAT.

Open! Sesame! | A Little Stepson.  
A Harvest of Wild | Fighting the Air.  
Oats. | Written in Fire.

BY J. MASTERMAN.

Half-a-dozen Daughters.

BY JEAN MIDDLEMASS.

Touch and Go. | Mr. Dorillon.

CHEAP POPULAR NOVELS, continued—

BY D. CHRISTIE MURRAY.

A Life's Atonement.  
A Model Father.  
Joseph's Coat.  
Coals of Fire.  
By the Gate of the Sea.

BY MRS. OLIPHANT.

Whiteladies.

BY MRS. ROBERT O'REILLY.

Phoebe's Fortunes.

BY OUIDA.

Held in Bondage.	Two Little Wooden
Strathmore.	Shoes.
Chandos.	Signa.
Under Two Flags.	In a Winter City.
Idalia.	Ariadne.
Cecil Castle-	Friendship.
maine.	Moths.
Tricotrin.	Pipistrello.
Puck.	A Village Com-
Folle Farline.	mune.
A Dog of Flanders.	Bimbi.
Pascarel.	In Maremma.

BY MARGARET AGNES PAUL.

Gentle and Simple.

BY JAMES PAYN.

Lost Sir Massing-	Like Father, Like
berd.	Son.
A Perfect Treas-	A Marine Resi-
ure.	dence.
Bentinck's Tutor.	Married Beneath
Murphy's Master.	Him.
A County Family.	Mirk Abbey.
At Her Mercy.	Not Wooed, but
A Woman's Ven-	Won.
geance.	£200 Reward.
Cecil's Tryst.	Less Black than
Clyffards of Clyffe	We're Painted.
The Family Scape-	By Proxy.
grace.	Under One Roof.
Foster Brothers.	High Spirits.
Found Dead.	Carlyon's Year.
Best of Husbands	A Confidential
Walter's Word.	Agent.
Halves.	Some Private
Fallen Fortunes.	Views.
What He Cost Her	From Exile.
Humorous Stories	A Grape from a
Gwendoline's Har-	Thorn.
vest.	For Cash Only.

BY EDGAR A. POE.

The Mystery of Marie Roget.

CHEAP POPULAR NOVELS, *continued*—

BY E. C. PRICE.

Valentina.

BY CHARLES READE.

It is Never Too Late to Mend.

Hard Cash.

Peg Woffington.

Christie Johnstone.

Griffith Gaunt.

Put Yourself in His Place.

The Double Marriage.

Love Me Little, Love Me Long.

Foul Play.

The Cloister and the Hearth.

The Course of True Love.

Autobiography of a Thief.

A Terrible Temptation.

The Wandering Heir.

A Simpleton.

A Woman-Hater.

Readiana.

BY MRS. J. H. RIDDELL.

Her Mother's Darling.

Prince of Wales's Garden Party.

BY F. W. ROBINSON.

Women are Strange.

BY BAYLE ST. JOHN.

A Levantine Family.

BY GEORGE AUGUSTUS SALA.

Gaslight and Daylight.

BY JOHN SAUNDERS.

Bound to the Wheel.

One Against the World.

Guy Waterman.

The Lion in the Path.

Two Dreamers.

BY ARTHUR SKETCHLEY.

A Match in the Dark.

BY T. W. SPEIGHT.

The Mysteries of Heron Dyke.

BY R. A. STERNDAL.

The Afghan Knife.

BY R. LOUIS STEVENSON.

New Arabian Nights.

BY BERTHA THOMAS.

Cressida. | Proud Maisie.

The Violin-Player.

BY W. MOY THOMAS.

A Fight for Life.

CHEAP POPULAR NOVELS, *continued*—

BY WALTER THORNBURY.

Tales for the Marines.

BY T. ADOLPHUS TROLLOPE.

Diamond Cut Diamond.

BY ANTHONY TROLLOPE.

The Way We Live Now.

The American Senator.

Frau Frohmann.

Marion Fay.

Kept in the Dark.

By FRANCES ELEANOR TROLLOPE

Like Ships Upon the Sea.

BY MARK TWAIN.

Tom Sawyer.

An Idle Excursion.

A Pleasure Trip on the Continent  
of Europe.

A Tramp Abroad.

The Stolen White Elephant.

BY SARAH TYTLER.

What She Came Through.

The Bride's Pass.

BY J. S. WINTER.

Cavalry Life. | Regimental Legends

BY LADY WOOD.

Sabina.

BY EDMUND YATES.

Castaway. | The Forlorn Hope.  
Land at Last.

ANONYMOUS.

Paul Ferroll.

Why Paul Ferroll Killed his Wife.

Fcap. 8vo, picture covers, 1s. each.

Jeff Briggs's Love Story. By BRET  
HARTE.The Twins of Table Mountain. By  
BRET HARTE.Mrs. Gainsborough's Diamonds. By  
JULIAN HAWTHORNE.Kathleen Mavourneen. By Author  
of "That Lass o' Lowrie's."Lindsay's Luck. By the Author of  
"That Lass o' Lowrie's."Pretty Polly Pemberton. By the  
Author of "That Lass o' Lowrie's."Trooping with Crows. By Mrs.  
PIRKIS.The Professor's Wife. By LEONARD  
GRAHAM.

A Double Bond. By LINDA VILLARI.

Esther's Glove. By R. E. FRANCHILLON.

The Garden that Paid the Rent.

By TOM JERROLD.



